Series 1961, No. 36

Issued January 1966

SOIL SURVEY
Crosby County, Texas

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with the
TEXAS AGRICULTURAL EXPERIMENT STATION

HOW TO USE THIS SOIL SURVEY REPORT

THIS SOIL SURVEY of Crosby County, Tex., will serve several groups of readers. It will help farmers and ranchers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; add to soil scientists' knowledge of soils; and help prospective buyers and others in appraising a farm or other tract.

Locating Soils

At the back of this report is an index map and a soil map consisting of many sheets. The index map is numbered to correspond to the sheets of the soil map, so that the sheet showing any area can be located easily. On each map sheet, the soil boundaries are outlined and there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where it belongs. For example, an area on the map has the symbol AfA. The legend for the set of maps shows that this symbol identifies Amarillo fine sandy loam, 0 to 1 percent slopes. That soil and all others mapped in the county are described in the section "Descriptions of the Soils."

Finding Information

In the "Guide to Mapping Units, Capability Units, and Range Sites" at the back of this report, the soils are listed in the alphabetic order of their map symbols. This guide shows where to find a description of each soil and a discussion of its capability unit and range site. It also shows where to find the acreage of each soil, the yields that can be expected, and information about engineering uses of the soils.

Farmers and ranchers and those who work with them can learn about the soils on a farm or ranch by reading the description of each soil and of its capability unit and other groupings. A convenient way of doing this is to turn to the soil map and list the symbols for the soils on the farm and then to use the "Guide to Mapping Units, Capability Units, and Range Sites" in finding the pages where each soil and its groupings are described.

Ranchers and others interested in range will find the section "Range Management" helpful. In that section the soils of the county are placed in groups according to their suitability as rangeland, and the management of each group is discussed.

Engineers and builders will find in the section "Engineering Uses of the Soils" tables that give engineering descriptions of the soils in the county; name soil features that affect engineering practices and structures; and rate the soils according to their suitability for several kinds of engineering work.

Scientists and others who are interested can read about how the soils were formed and how they are classified in the section "Formation and Classification of the soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers in Crosby County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County," which gives additional information about the county.

* * * * *

The soil survey of Crosby County is part of the technical assistance the Soil Conservation Service provides for farmers and ranchers in the Crosby County Soil Conservation District. This District was organized by farmers and ranchers in the county on March 20, 1941.

Fieldwork for this survey was completed in 1961. Unless otherwise indicated, all statements in the report refer to conditions in the county at the time the survey was in progress.

Cover picture.—Combining grain sorghum in Crosby County.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402

Contents

Series 1961, No. 36

Issued January 1966

SOIL SURVEY OF CROSBY COUNTY, TEXAS

BY WILLIAM M. KOOS, LEE A. PUTNAM, AND WAYBURN D. MITCHELL,
SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE
TEXAS AGRICULTURAL EXPERIMENT STATION

CROSBY COUNTY is in the west-central part of Texas and is in the High Plains section of the Southern Great Plains. The area of the county is about 583,040 acres, or 911 square miles. The location of Crosby County in Texas is shown in figure 1.

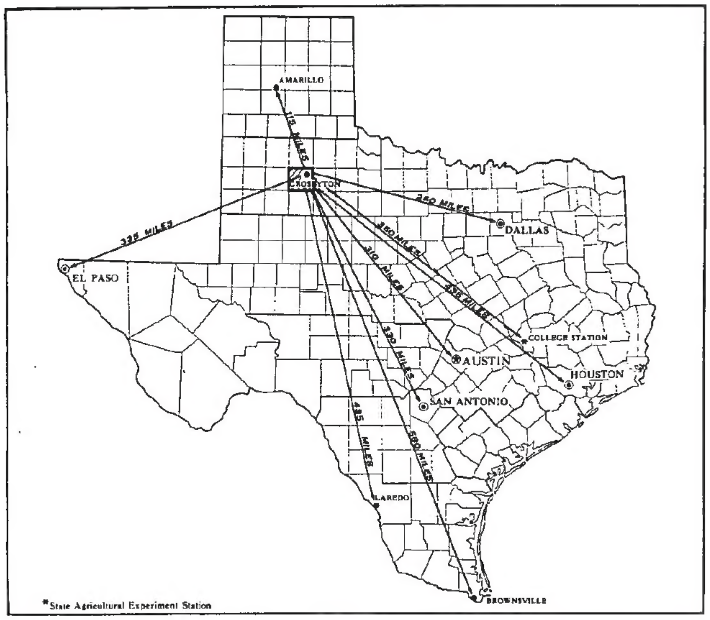


Figure 1.—**Location of Crosby County in Texas.**

Crosbyton, the county seat, has a population of about 2,088. It is located 37 miles east of Lubbock. Crosbyton and Ralls are trading centers for the livestock and farming communities.

Approximately 55 percent of the total acreage is in crops. Irrigated cotton and wheat are the main cash crops, but other small grains, and corn, sorghum, and some vegetables are also grown. Like other counties in west Texas, Crosby County has periods of drought. Rainfall is adequate during some years, but satisfactory yields are produced during dry years only on irrigated soils.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Crosby County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Abilene and Miles, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural landscape. Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, soil types are defined. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Miles fine sandy loam and Miles loamy fine sand are two soil types in the Miles series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Miles fine sandy loam, 1 to 3 percent slopes, is one of several phases of Miles fine sandy loam, a soil type that ranges from nearly level to gently sloping.

After a guide for classifying and naming the soils

had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show buildings, field borders, trees, and other details that greatly help in drawing boundaries accurately. The soil map in the back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas of soils that are so intricately mixed, and so small in size, that it is not practical to show them separately on the map. Therefore, they show these soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major soil series in it, for example, Mansker-Potter complex. Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Rough broken land or Loamy alluvial land, and are called land types rather than soils.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey reports. Based on the yield and practice tables and other data, the soil scientists set up trial groups, and test them by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

After study of the soils in a locality and the way they are arranged, it is possible to make a general map that shows several main patterns of soils, called soil associations. Such a map is the colored general soil map in the back of this report. Each association, as a rule, contains a few major soils and several minor soils in a pattern that is characteristic although not strictly uniform.

The soils within any one association are likely to differ in some or in many properties; for example, slope, depth, stoniness, or natural drainage. Thus, the general soil map shows, not the kind of soil at any particular place, but several distinct patterns of soils. Each pattern, furthermore, contains several kinds of soils.

Each soil association is named for the major soil series in it, but as already noted, soils of other series may also be present. The major soils of one soil association may also be present in another association, but in a different pattern.

The general map is useful to people who want a general idea of the soils, who want to compare different parts of a county, or who want to know the possible location of good-sized areas suitable for a certain kind of farming or other land use.

The general soil map of Crosby County shows seven soil associations in two general kinds of landscapes, the High Plains and the Rolling Plains. These two landscapes are divided by a caprock escarpment.

Soil Associations of the High Plains

The High Plains, the most extensive area in the county, is the smooth, level plain above the steep caprock escarpment. There are four soil associations on the High Plains. They range from deep sands in the southern part of the High Plains to deep hardland soils in the northern part.

1. Pullman association: Deep hardland

This association consists of nearly level, moderately fine textured soils. It occurs in one large, continuous body in the northern and northeastern parts of the county. The surface is relatively smooth, except for the playas that receive most of the drainage and runoff (fig. 2). This association occupies about 31 percent of the county.

The Pullman are the major soils in the association. They have a dark-colored silty clay loam surface layer that grades to a dense clayey subsoil. The Randall, Berthoud, Mansker, Potter, and Lofton soils are minor soils in the association.

The Pullman soils are fertile, but crop yields under dryland farming are low during years when rainfall is inadequate. Most of the acreage is farmed to irrigated cotton and wheat. If the soils are left unprotected, there is a slight hazard of wind erosion. Growing soil-improving crops and leaving crop residue on the surface help to keep the surface soil friable and to reduce the amount of crusting.

2. Olton association: Mixed land

This association consists of a broad plain that is nearly level to gently sloping. In some places it is broken by playa basins that receive most of the drainage and runoff. The association makes up about 27 percent of the county and is in the west-central part.

The Olton are the major soils in the association (fig. 3). These soils have a reddish-brown to dark-brown surface layer that grades to a blocky clay loam subsoil. The Randall, Mansker, and Lofton soils make up a small percentage of the association.

Nearly all of the acreage is cultivated and irrigated. Cotton, wheat, and grain sorghum are the main crops.

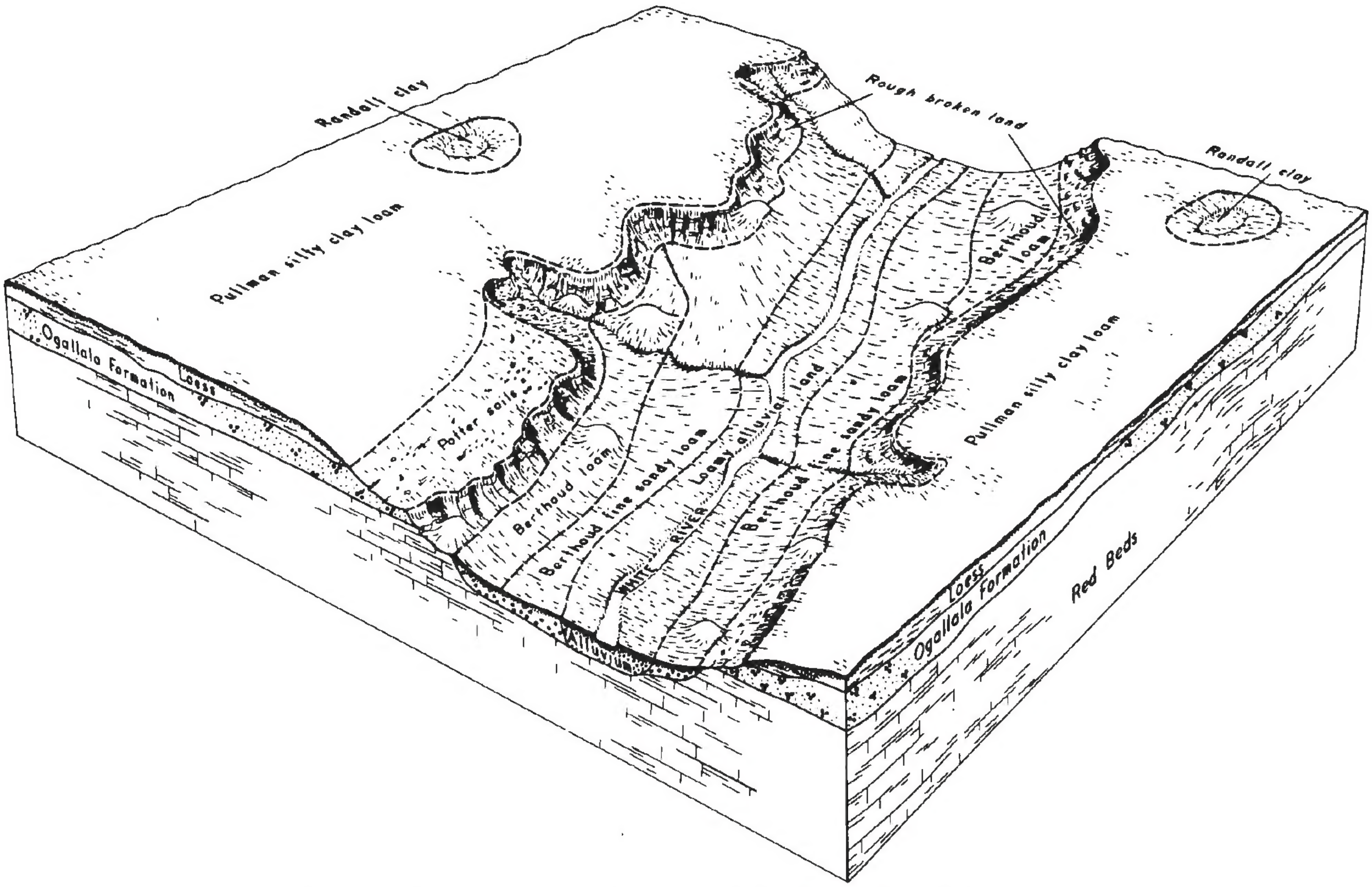


Figure 2.—**Pullman soils are on the upland in the Pullman soil association.**

The soils are fertile and are easily tilled. Because of the limited rainfall, crop yields are low in dry-farmed areas. The hazard of wind erosion is slight on areas that are not protected. Growing soil-improving crops and leaving crop residue on the surface help to keep the surface soil friable and reduce the amount of crusting. These practices also help to control wind erosion.

3. Amarillo association: Moderately sandy land

This association consists of moderately coarse textured soils that are nearly level to gently sloping. It occurs as a narrow band in the western part of the county near the communities of Cap Rock and Robertson. The association makes up 8 percent of the county.

The major soils in the association are the Amarillo. The surface layer of these soils is brown to reddish-brown, friable fine sandy loam that grades to a subsoil of reddish-brown, friable sandy clay loam. The Brownfield, Mansker, and Portales are minor soils in the association.

Most of the acreage is used for irrigated cotton and grain sorghum. The Amarillo soils are moderately fertile and are easily cultivated. If left unprotected, they are moderately susceptible to wind erosion. Leaving crop residue on the surface helps to keep the surface soil friable and to control erosion.

4. Amarillo-Brownfield association: Sandy land

This association consists of coarse-textured, gently rolling soils. It is in the western part of the county, above the caprock escarpment, and south of the community of Robertson. This association, the smallest in the High Plains, makes up 2 percent of the county.

The Amarillo and Brownfield are the major soils of the association. The Amarillo are the most extensive. Their surface layer is brown, loose loamy fine sand that overlies a subsoil of friable, reddish-brown sandy clay loam. The Brownfield soils have a thicker, more sandy surface layer than the Amarillo but have similar characteristics in the subsoil. Minor areas of Amarillo fine sandy loam and Tivoli fine sand are also in the association.

Nearly 60 percent of this association is cultivated. The main crops are grain sorghum and cotton. If left unprotected, the soils in this association are highly susceptible to wind erosion. Because of blowing, some fields have been abandoned. In these places the soils are low in plant nutrients.

Soil Associations of the Rolling Plains

The Rolling Plains, in the southeastern part of the county, is a smaller, more complex area than the High Plains. There are three soil associations in the Rolling

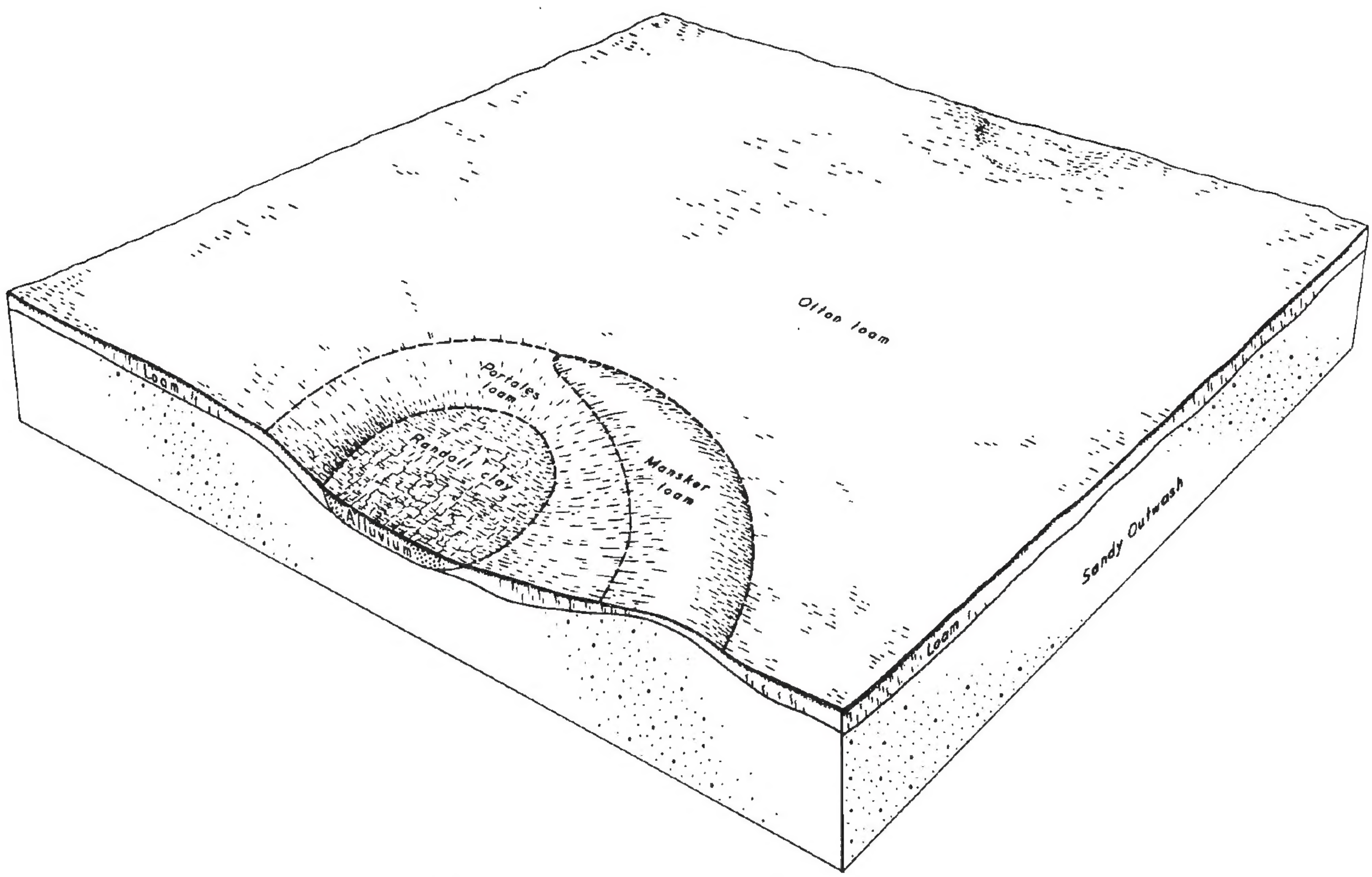


***Figure 3.*—A typical area in the Olton association.**

Plains. They range from deep sands to mixed lands, but they include some deep hardland soils.

Although the Rolling Plains were once mantled by outwash, they have since been eroded and deeply entrenched by rivers and streams. As a result, in many places the Triassic and Permian red beds that underlie the entire area are exposed. Adjacent to the caprock escarpment are complex areas of soils that are remnants of the High Plains. Geological erosion or deposition from the High Plains has formed this complex pattern of soils.

Figure 4 shows areas of Miles and Abilene soils formed from outwash and the lower lying Vernon soils that formed in material from red beds.

5. Berthoud-Mansker-Potter association: Shallow land

This association is the largest in the Rolling Plains part of the county. It is parallel to the caprock escarpment and extends to a point 1 to 3 miles below it. The soils are in such complex patterns that they resemble a series of immature mountains and valleys. This association makes up about 22 percent of the county.

The Berthoud, Mansker, and Potter are the major soils in the association. The Berthoud are the most extensive. They have a pale-brown to dark-brown surface layer that grades to a subsoil of very pale brown or light-brown fine sandy loam or loam. The Mansker are brown to dark grayish brown and contain more lime than the Berthoud soils. The Potter soils, in contrast to the Berthoud and Mansker, are very shallow and are brown to dark grayish brown. Also, the Potter soils are underlain by weakly cemented lime or caliche. The Spur, Bippus, Vernon, Miles, and Likes soils, as well as areas of Rough broken land, make up a small amount of the association.

Practically all of this association is rangeland.

6. Miles-Mansker association: Moderately sandy land

This association consists of gently sloping to moderately sloping soils that occur in an almost continuous band along the southern part of the county. Figure 5 shows a typical soil pattern in the Miles-Mansker association. This association covers about 8 percent of the county.

The Miles and Mansker are the major soils in the association. The Miles have a surface layer of reddish-brown fine sandy loam that grades to a subsoil of reddish-brown or yellowish-red sandy clay loam. They are deep, moderately fertile soils and are on the upland. The Mansker soils have a brown to dark grayish-brown surface layer over a pale-brown to grayish-brown subsoil. These soils are shallow and contain more lime than the Miles soils.

Areas of Vernon, Spur, and Abilene soils and of Travessilla fine sandy loam, and of the land types Badland and Loamy alluvial land, are widely scattered throughout the association.

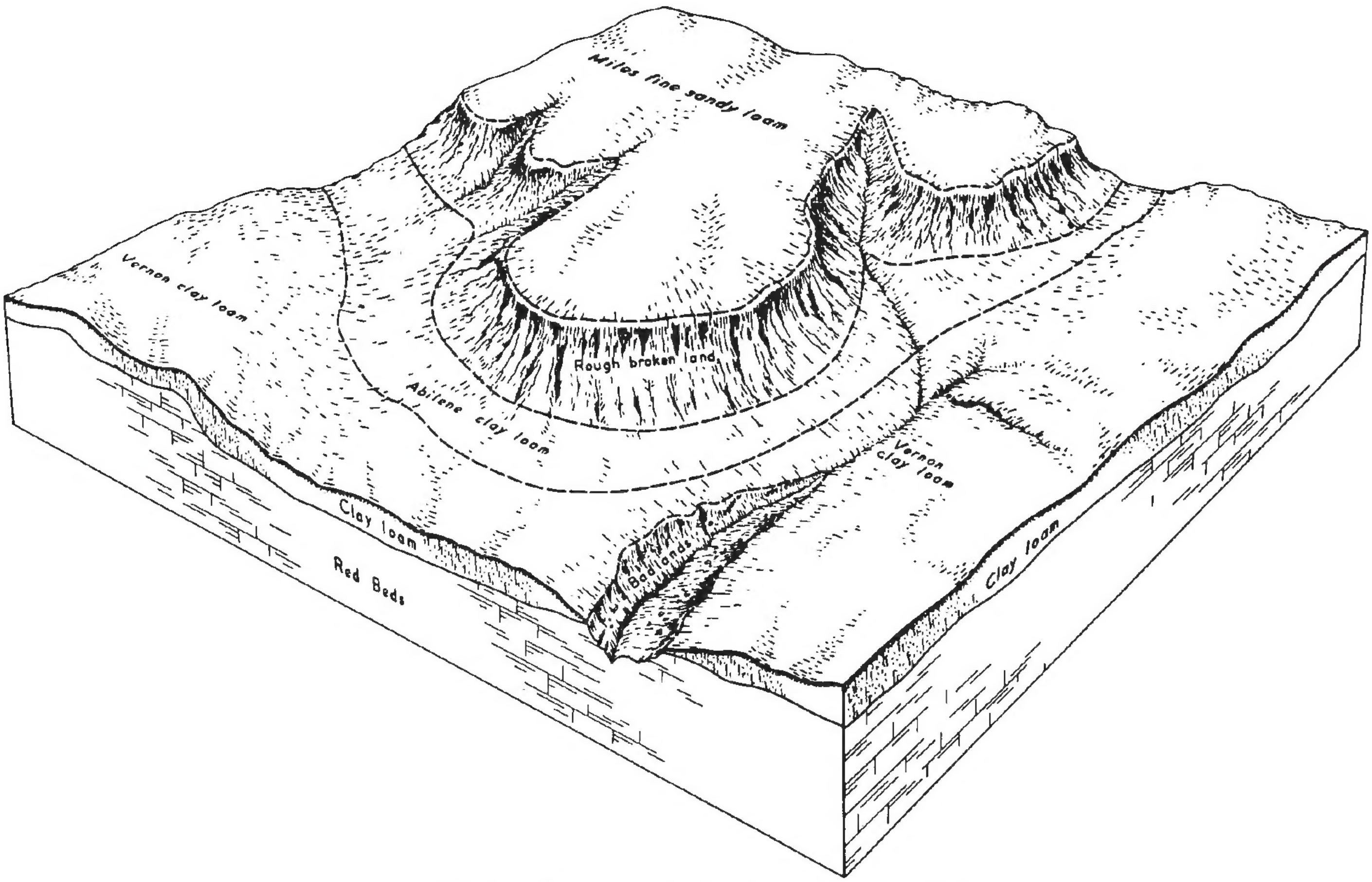


Figure 4.—Various soils formed in the Rolling Plains.

Most of this association is used for range, but a few areas of the Miles soils are cultivated and are used for cotton and grain sorghum. If left unprotected, these soils are moderately susceptible to erosion by wind and water.

7. *Brownfield-Miles association: Sandy land*

This association consists of gently sloping to moderately sloping soils. The soils are in two small areas in the southeastern part of the county. This association covers 2 percent of the acreage of the county.

The major soils in the association are the Brownfield and Miles. The Brownfield soils have a surface layer of very pale brown to brown fine sand that grades to a subsoil of red or reddish-yellow sandy clay loam. The Miles soils have a thinner, less sandy surface layer than the Brownfield but have somewhat similar subsoil characteristics. Also in this association are small areas of Tivoli fine sand.

Most of the acreage of this association is used for range. A few areas of the Brownfield soils were cultivated but, because of severe wind erosion, are now abandoned. Most cultivated areas consist of the Miles soils, which are used for cotton and grain sorghum.

The soils in this association are highly susceptible to wind erosion in unprotected areas. They are low in available plant nutrients and have a low capacity for holding moisture.

Descriptions of the Soils

In this section the soil series in Crosby County are described first in alphabetic order, and then the mapping units in each series. Thus, for the reader to obtain full information on any mapping unit, it is necessary to read both the description of the soil and that of the soil series. Technical descriptions of the soils are given in the section "Formation and Classification of Soils." The approximate acreage and the proportionate extent of the soils are shown in table 1. Some terms used to describe the soils that may not be familiar to the reader are defined in the Glossary. The location of the soils is shown on the detailed soil map at the back of the report.

Following the name of each soil in the soil descriptions is a symbol in parentheses that identifies the soil on the detailed soil map. Listed at the end of each soil description are the capability unit and the range site in which the soil was placed.

The mapping units and map symbols for each unit are listed in the "Guide to Mapping Units, Capability Units, and Range Sites" at the end of the report.

Abilene Series

The Abilene series is made up of deep, dark, crumbly soils of the upland. The soils are nearly level to gently

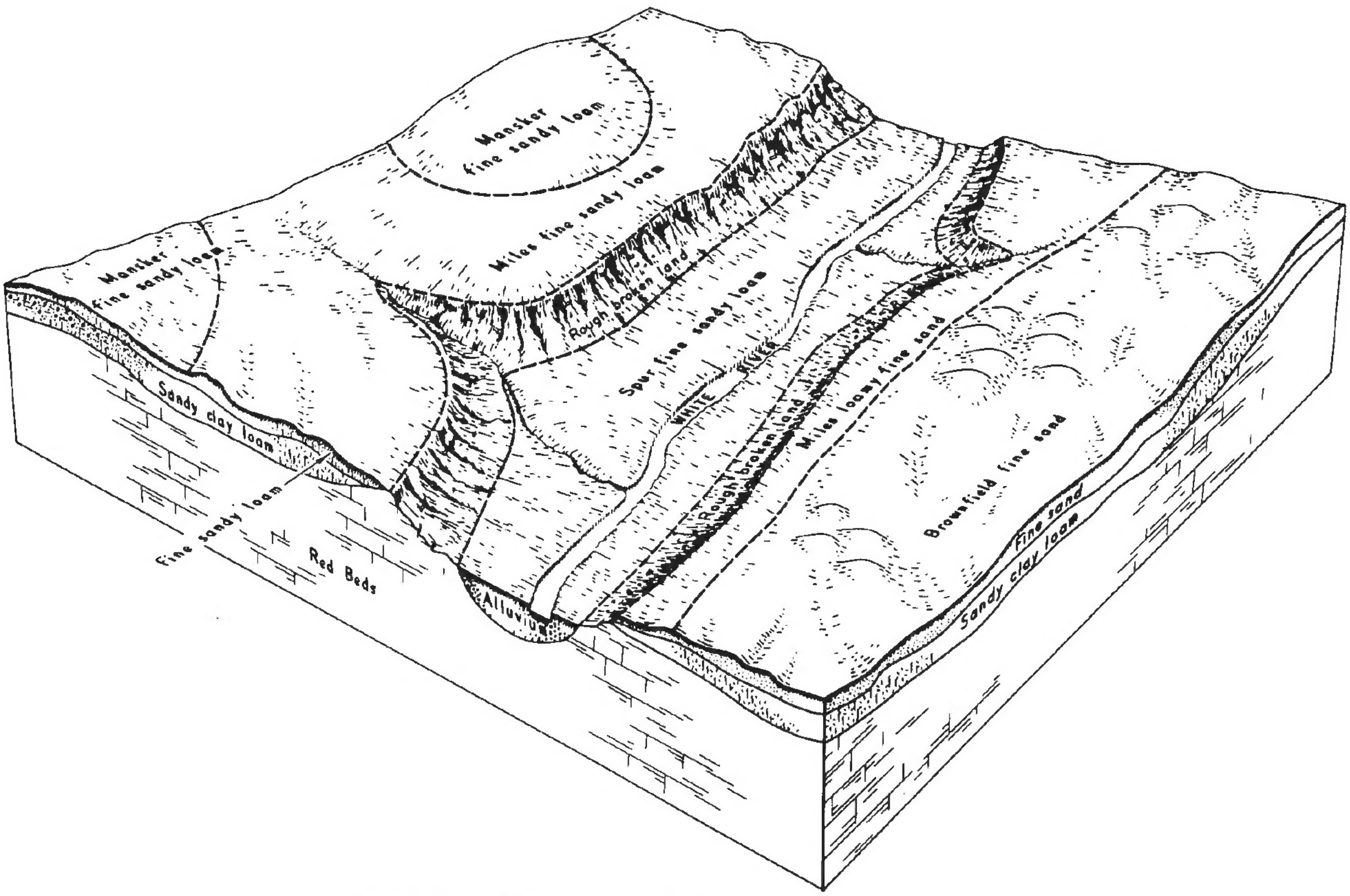


Figure 5.—A typical area in the Miles-Mansker association.

sloping and are in the southern part of the county. The native vegetation consists of short and mid grasses.

The surface layer is brown to dark grayish-brown clay loam about 7 inches thick. It has granular structure and is hard when dry but friable when moist.

The subsoil to a depth of about 40 inches is brown to dark grayish-brown clay loam. This layer is more clayey as the depth increases. It is blocky and very hard when dry but is firm when moist. The lower part contains some lime.

The substratum is reddish-yellow to very pale brown clay loam. It consists of old water-laid deposits that contain a considerable amount of lime.

The surface soil is calcareous in some areas. The thickness of the surface layer ranges from 4 to 8 inches; that of the subsoil ranges from 22 to 55 inches.

The Abilene soils have a darker, less sandy subsoil than the Miles soils. They are less red than the Olton soils of the High Plains.

Abilene clay loam, 0 to 1 percent slopes (AbA).—This soil is nearly level and is easily tilled. It is fertile and has adequate drainage.

Nearly 7 percent of the acreage mapped consists of small areas of other soils: Bippus clay loam, 1 to 3 percent slopes; Spur clay loam; and Abilene clay loam, 1 to 3 percent slopes.

Except for a few areas, all of Abilene clay loam, 0 to 1 percent slopes, is in range. If cultivated, this soil is suitable for small grain, grain sorghum, and cotton. There is a slight hazard of wind erosion if the soil is not protected. Use of crop residue is needed to control soil blowing and maintain fertility. (Capability unit IIce-2, dryland; Deep Hardland range site)

Abilene clay loam, 1 to 3 percent slopes (AbB).—This soil is on gently sloping ridges above drainageways. The average slope is about 1. 8 percent.

A few, small included areas of Miles fine sandy loam, 1 to 3 percent slopes, and of Abilene clay loam, 0 to 1 percent slopes, make up about 6 percent of the mapped area.

Abilene clay loam, 1 to 3 percent slopes, is droughty. It is fairly easy to till and makes a fair seedbed. Yields of crops are moderate. In some cultivated fields there are a few shallow gullies 1 to 2 feet deep and 3 to 8 feet wide. If left unprotected, the soil is slightly susceptible to wind erosion and is moderately susceptible to water erosion. Terracing and use of crop residue are needed for control of wind and water erosion. These practices also help to conserve moisture and maintain fertility. (Capability unit IIIe-2, dryland; Deep Hardland range site)

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Abilene clay loam, 0 to 1 percent slopes	3, 328	0. 6	Miles loamy fine sand, 0 to 3 percent slopes	3, 751	0. 6
Abilene clay loam, 1 to 3 percent slopes	6, 291	1. 1	Miles loamy fine sand, 3 to 5 percent slopes	916	. 2
Amarillo fine sandy loam, 0 to 1 percent slopes	28, 232	5. 0	Olton loam, 0 to 1 percent slopes	109, 814	18. 8
Amarillo fine sandy loam, 1 to 3 percent slopes	4, 983	. 9	Olton loam, 1 to 3 percent slopes	14, 960	2. 6
Amarillo loamy fine sand, 0 to 3 percent slopes	7, 216	1. 2	Portales fine sandy loam, 0 to 1 percent slopes	2, 372	. 4
Badland	4, 178	. 7	Portales fine sandy loam, 1 to 3 percent slopes	357	([1])
Berthoud fine sandy loam, 1 to 3 percent slopes	2, 673	. 5	Portales loam, 0 to 1 percent slopes	6, 038	1. 0
Berthoud fine sandy loam, 3 to 5 percent slopes	4, 201	. 7	Portales loam, 1 to 3 percent slopes	9, 394	1. 6
Berthoud fine sandy loam, 5 to 8 percent slopes	8, 393	1. 4	Potter soils	4, 625	. 8
Berthoud loam, 3 to 5 percent slopes	1, 567	. 3	Pullman silty clay loam, 0 to 1 percent slopes	137, 259	23. 5
Berthoud loam, 5 to 8 percent slopes	3, 585	. 6	Pullman silty clay loam, 1 to 3 percent slopes	6, 338	1. 1
Bippus clay loam, 1 to 3 percent slopes	4, 245	. 7	Randall clay	18, 068	3. 1
Brownfield fine sand	9, 174	1. 6	Randall fine sandy loam	398	([1])
Brownfield soils, severely eroded	1, 407	. 2	Rough broken land	2, 359	. 4
Drake clay loam, 1 to 3 percent slopes	2, 217	. 4	Sandy alluvial land	1, 736	. 3
Drake clay loam, 3 to 5 percent slopes	514	([1])	Spur clay loam	2, 543	. 4
Hilly gravelly land	659	. 1	Spur fine sandy loam	4, 674	. 8
Likes loamy fine sand	911	. 2	Stamford clay, 1 to 3 percent slopes	1, 969	. 3
Loamy alluvial land	6, 286	1. 1	Stamford soils, 0 to 1 percent slopes	1, 970	. 3
Lofton clay loam	5, 585	1. 0	Tivoli fine sand	488	([1])
Lofton fine sandy loam	867	. 1	Vernon clay loam, 1 to 3 percent slopes	2, 200	. 4
Mansker fine sandy loam, 0 to 1 percent slopes	464	([1])	Vernon clay loam, 3 to 15 percent slopes	24, 541	4. 2
Mansker fine sandy loam, 1 to 3 percent slopes	1, 727	. 3	Vernon-Travessilla complex	12, 111	2. 1
Mansker fine sandy loam, 3 to 5 percent slopes	10, 091	1. 7	Zita fine sandy loam, 0 to 1 percent slopes	3, 083	. 5
Mansker loam, 0 to 1 percent slopes	702	. 1	Zita loam, 0 to 1 percent slopes	5, 803	1. 0
Mansker loam, 1 to 3 percent slopes	2, 508	. 4	Zita loam, 1 to 3 percent slopes	2, 644	. 5
Mansker loam, 3 to 5 percent slopes	1, 160	. 2	Gravel and caliche pits and stowage	970	. 2
Mansker-Potter complex	53, 570	9. 2	River channels	2, 845	. 5
Miles fine sandy loam, 0 to 1 percent slopes	1, 990	. 3			
Miles fine sandy loam, 1 to 3 percent slopes	15, 322	2. 6	Total	583, 040	100. 0
Miles fine sandy loam, 3 to 5 percent slopes	4, 768	. 8			

[1] Less than 0.1 percent.

Amarillo Series

The Amarillo series consists of deep, brown to reddish-brown, well-drained soils of the upland. These soils are nearly level to gently sloping and are mostly in the southwestern part of the county.

In some areas the surface layer is granular, brown to reddish-brown fine sandy loam that on the average is about 10 inches thick. It is hard when dry but very friable when moist. In other areas this layer is loamy fine sand and on the average is about 16 inches thick. It is loose when dry and moist.

The subsoil is reddish-brown sandy clay loam that extends to a depth of about 40 inches. This layer has prismatic and subangular blocky structure. Moisture and plant roots can penetrate it with little difficulty. The lower part is more sandy and lighter in color as depth increases. The underlying material consists of wind-laid deposits. Figure 6 shows a profile of an Amarillo soil.

The surface layer of the fine sandy loams ranges from 6 to 12 inches in thickness, but that of the loamy fine sands ranges between 12 and 20 inches. The thickness of the subsoil ranges from 22 to 65 inches. In some places there is no lime.

The Amarillo soils have a thinner, less sandy surface soil than the Brownfield. They have a less clayey and more friable subsoil than the Olton soils and are more red throughout their profile than the Zita and Portales soils.

The Amarillo are among the better soils for dryland and irrigation farming in the county. These soils have a high moisture-supplying capacity. They are well suited to most general crops and grasses adapted to the area. Cotton and grain sorghum are the principal cultivated crops.

Amarillo fine sandy loam, 0 to 1 percent slopes (AfA).—This soil is the dominant one in the Amarillo series. It occupies large nearly level areas that are generally 200 acres or more in size. The average slope is about 0.5 percent. The soil absorbs most of the rain that falls.

Nearly 6 percent of the acreage mapped consist of Portales fine sandy loam, 0 to 1 percent slopes; Zita fine sandy loam, 0 to 1 percent slopes; and Mansker fine sandy loam, 0 to 1 percent slopes. Also included are small areas of Amarillo fine sandy loam, 1 to 3 percent slopes, and small, round knobs of Amarillo loamy fine sand. The inclusions do not affect the use and management of the soils.

Most areas of Amarillo fine sandy loam, 0 to 1 percent slopes, are cultivated. Unprotected areas are moderately susceptible to wind erosion. In a few areas the surface layer has lost some silt and clay and is now loamy fine sand. The use of crop residue and fertilizer is needed to control soil blowing and maintain fertility. (Capability unit IIIe-4, dryland; capability unit IIe-4, irrigated; Sandy Loam range site)

Amarillo fine sandy loam, 1 to 3 percent slopes (AfB).—Most of this gently sloping soil is on low, narrow ridges and in concave areas surrounding playa basins.

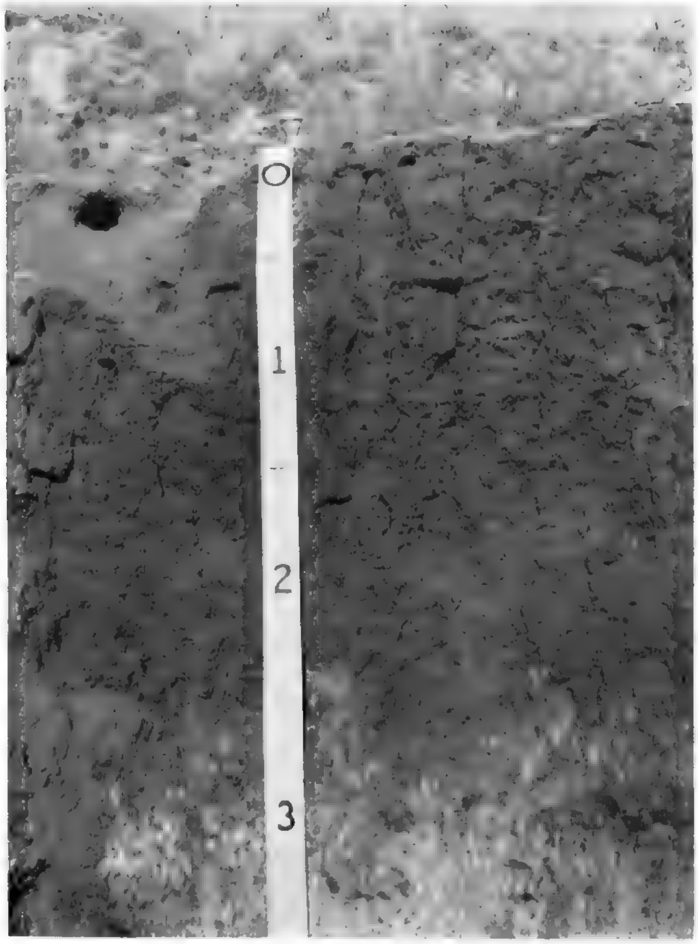


Figure 6.—**Profile of Amarillo fine sandy loam; the depth shown is more than 3 feet.**

Slopes average about 1.8 percent. In some areas the surface layer is only 4 to 5 inches thick. Also, in places the lime accumulation is about 22 inches from the surface.

As much as 7 percent of the acreage mapped consists of small areas of Amarillo loamy fine sand, 0 to 3 percent slopes; Amarillo fine sandy loam, 0 to 1 percent slopes; and Mansker fine sandy loam, 1 to 3 percent slopes. Because of the small size, the inclusions do not much affect use and management.

If left unprotected, Amarillo fine sandy loam, 1 to 3 percent slopes, is susceptible to wind and water erosion. During rains of high intensity, water erosion takes place near the lower slopes adjacent to playas. Some shallow gullies and small rills form after such rains, but these are generally not evident after one or two cultivations. In places the silt and clay have been blown away, and in these places the present surface layer is sandier than it was formerly. Terracing and the use of crop residue and fertilizer are needed to control wind and water erosion and to conserve moisture and maintain fertility. (Capability unit IIIe-4, dryland; capability unit IIIe-5, irrigated; Sandy Loam range site)

Amarillo loamy fine sand, 0 to 3 percent slopes (AmB).—This soil has nearly level to gentle slopes that average about 1 percent. It absorbs water readily. Little runoff occurs, even after a heavy rain. The surface layer is low in natural fertility.

Most of the acreage is only slightly eroded, but a few small, included areas have lost most of their surface soil through erosion. Nearly 4 percent of the acreage mapped consists of small areas of Brownfield fine sand and Amarillo fine sandy loam, 1 to 3 percent slopes. Because of their size, the inclusions are used and managed about the same as Amarillo loamy fine sand, 0 to 3 percent slopes.

If left unprotected, this soil is highly susceptible to wind erosion, and in some areas a few small sandy mounds have been formed by wind erosion. Most areas have been deep plowed to a depth of 14 to 20 inches. Deep plowing turns up the moderately fine textured subsoil, which forms clods for protection from blowing. Stubble mulching and use of crop residue and fertilizer are needed to control blowing and maintain fertility. (Capability unit IVe-4, dryland; capability unit IIIe-7, irrigated; Sandy Land range site)

Badland (Ba)

This miscellaneous land type consists mainly of shale and clay derived from red beds. The areas are mostly below steep, narrow escarpments in the eastern part of the county. In places quartz pebbles and sandstone rock are scattered over the surface. The average slope is about 15 percent.

Most areas of Badland are surrounded by steep sandstone escarpments that have slopes ranging from 30 to 150 percent. These escarpments make up a small part of the acreage. Between the escarpments are less sloping areas in gullies, on ridges, and on alluvial flats that consist of nearly barren shale and clay from the red beds.

Most areas of Badland were formed as a result of geologic erosion. The highly erodible clay from the red beds was washed away, and deeply entrenched valleys and gullies remain. Only a few scattered clumps of short grass grow in these areas. (Capability unit VIIIs-1, dryland; not assigned to a range site)

Berthoud Series

The Berthoud series consists of deep, dark, calcareous soils of the upland. These soils are on foot slopes below the steep caprock escarpment in the Rolling Plains part of the county.

The surface layer, to a depth of about 10 inches, is calcareous, very pale brown to dark-brown fine sandy loam or loam that is hard when dry but very friable when moist. It has prismatic and subangular blocky structure (fig. 7).

The subsoil is very pale brown to light-brown fine sandy loam or loam about 20 inches thick. It has prismatic and subangular blocky structure, is hard when dry but friable when moist, and in most areas contains lime.

The underlying material consists of highly calcareous fine sandy loam and loam of ancient alluvial origin.

The surface layer of these soils ranges from 5 to 12 inches in thickness. In some places it is reddish brown and noncalcareous. The subsoil ranges from 12 to 30 inches in thickness.

The Berthoud soils are deeper than the Mansker soils and have less lime in the subsoil. They have a lighter colored surface layer than the Bippus soils.

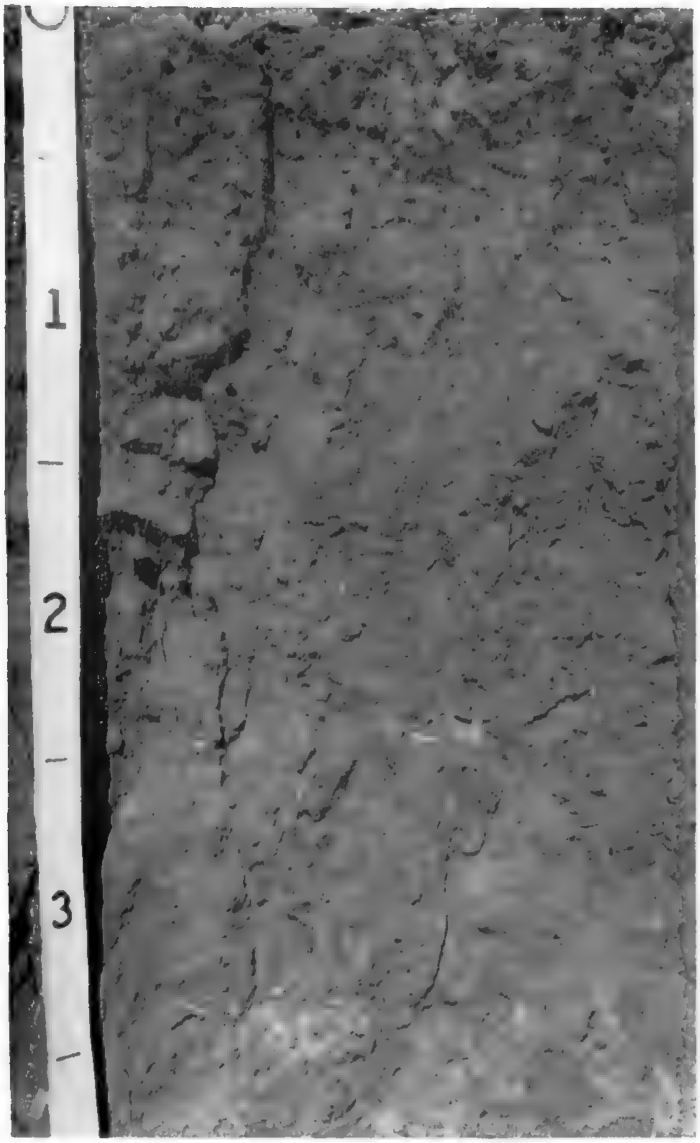


Figure 7.—**Profile of Berthoud loam; the measure is marked in feet.**

The Berthoud soils are not well suited to cultivation, and almost all of their acreage has been kept in range. The native vegetation recovers quickly from droughts or overgrazing. Except where they receive runoff from higher surrounding soils, Berthoud soils absorb nearly all rainfall.

Berthoud fine sandy loam, 1 to 3 percent slopes (BfB).—This soil has gentle, convex slopes that average about 2 percent. It is moderately fertile and has good drainage. It soaks up most of the rainfall, except in areas where runoff from surrounding higher areas accumulates. A few gullies have formed in these areas.

Nearly 4 percent of the acreage mapped consists of small areas of Mansker fine sandy loam, 1 to 3 percent slopes; Spur fine sandy loam; and Berthoud fine sandy loam, 3 to 5 percent slopes.

Most of Berthoud fine sandy loam, 1 to 3 percent slopes, is in range, but a few areas are dry farmed. Wind erosion is moderate in unprotected areas. In some places the surface layer has been winnowed and is now a loamy fine sand. Use of crop residue and terracing are needed for control of wind and water erosion and to conserve moisture and maintain fertility. (Capability unit IIIe-6, dryland; Sandy Loam range site)

Berthoud fine sandy loam, 3 to 5 percent slopes (BfC).—This soil has convex and smooth slopes that average about 4 percent.

About 6 percent of the acreage mapped consists of Mansker fine sandy loam, 3 to 5 percent slopes; Berthoud loam, 3 to 5 percent slopes; Potter soils; Miles fine sandy loam, 1 to 3 percent slopes; and Berthoud fine sandy loam, 5 to 8 percent slopes.

Nearly all of Berthoud fine sandy loam, 3 to 5 percent slopes, is in range; however, a few areas have been cultivated and are used for sudangrass or other supplemental feed crops. If the areas are cultivated and not protected, they are moderately susceptible to wind and water erosion. In some places runoff has cut shallow gullies. Terracing and use of crop residue are needed to keep the soil from washing and blowing and to conserve moisture and maintain fertility. (Capability unit IVe-3, dryland; Sandy Loam range site)

Berthoud fine sandy loam, 5 to 8 percent slopes (BfD).—This soil has convex and smooth slopes that average about 7 percent. It is the dominant soil in the Berthoud series.

About 12 percent of the acreage mapped consists of small areas of Potter soils; Mansker fine sandy loam, 3 to 5 percent slopes; Likes loamy fine sand; and Miles fine sandy loam, 3 to 5 percent slopes. Also included are small acreages of Berthoud fine sandy loam and Berthoud loam, 3 to 5 percent slopes.

Although most of Berthoud fine sandy loam, 5 to 8 percent slopes, is in range, some areas where runoff concentrates have been deeply gullied. Most of the gullies are about 6 to 10 feet deep and 8 to 10 feet wide, but a few are as much as 30 feet deep and 20 feet wide. If the soil is left unprotected, the hazard of wind erosion is moderate and that of water erosion is high. Controlled grazing is needed to maintain a cover of grass for control of runoff and erosion. (Capability unit VIe-2, dryland; Sandy Loam range site)

Berthoud loam, 3 to 5 percent slopes (BmC).—This soil has convex and smooth slopes that average about 4 percent. It is mainly adjacent to and paralleling drainageways.

About 4 percent of the acreage mapped consists of small areas of Potter soils; Bippus clay loam, 1 to 3 percent slopes; Mansker fine sandy loam, 1 to 3 percent slopes; Berthoud fine sandy loams; and Berthoud loam, 5 to 8 percent slopes.

Nearly all of Berthoud loam, 3 to 5 percent slopes, remains in range. Because of slope, the hazard of water erosion is moderate. A few shallow gullies occur in places where runoff concentrates. Controlled grazing is needed to maintain a cover of grass that can control erosion and runoff. (Capability unit IVe-1, dryland; Deep Hardland range site)

Berthoud loam, 5 to 8 percent slopes (BmD).—Most of this soil is in long, narrow bands below the caprock escarpment. Slopes average about 7 percent.

In places as much as 5 percent of the acreage mapped consists of small areas of Mansker fine sandy loam, 3 to 5

percent slopes; Potter soils; Berthoud fine sandy loam; and Berthoud loam with slopes of less than 5 percent.

Berthoud loam, 5 to 8 percent slopes, is used mainly for range. If left unprotected, it is highly susceptible to water erosion. Controlled grazing is needed for maintaining a cover of grass that helps to control runoff and erosion. (Capability unit VIe-1, dryland; Deep Hardland range site)

Bippus Series

The Bippus series consists of deep, dark, friable soils of the upland. These soils are on gentle to moderate slopes below the caprock escarpment. They are scattered throughout the southern and east-central parts of the county.

The surface layer is brown to dark grayish-brown clay loam about 14 inches thick. It is hard when dry but friable when moist. It has prismatic and granular structure.

The subsoil to a depth of about 40 inches is very pale brown to dark-brown clay loam. This layer has prismatic and subangular blocky structure and is hard when dry but friable when moist. Ordinarily, lime accumulates in this layer. The underlying material is pale-brown clay loam that contains much lime.

The surface layer ranges from 11 to 20 inches in thickness. It is calcareous in some places. The subsoil ranges from loam to clay loam in texture and from 10 to 30 inches in thickness.

These soils have a thicker, darker surface layer than the Berthoud soils. Their surface layer and subsoil are thicker than those of the Mansker soils and contain less lime. Bippus soils occupy higher, more sloping positions than the Spur soils.

Bippus clay loam, 1 to 3 percent slopes (BfB).—This soil has gentle, concave slopes that average about 1.8 percent. It is moderately fertile and has good internal drainage.

Nearly 12 percent of the acreage mapped consists of Spur clay loam; Berthoud loam, 3 to 5 percent slopes; Berthoud fine sandy loam, 1 to 3 percent slopes; and Mansker fine sandy loam, 1 to 3 percent slopes. These inclusions do not affect the production, use, or management of this soil.

Most areas of this Bippus soil are used mainly for range. If cultivated, the soil tills easily and makes a good seedbed. Wheat and grain sorghum are the main crops. If the soil is unprotected, the risk of wind and water erosion is slight. In places where runoff concentrates, there are a few shallow gullies. Terracing and use of crop residue are needed to control wind and water erosion, conserve moisture, and maintain fertility. (Capability unit IIe-1, dryland; Deep Hardland range site)

Brownfield Series

The Brownfield series consists of light-colored, deep sands of the upland. These soils are in smooth to rolling areas in the west-central and southeastern parts of the county.

The surface layer is very pale brown to brown fine sand, and on the average is about 22 inches thick. It is loose when dry and moist.

The subsoil is red to yellowish-red sandy clay loam. It has prismatic and subangular blocky structure and is very hard when dry but friable when moist. This layer is more sandy with increase in depth and extends to a depth of about 52 inches. It is easily penetrated by moisture and plant roots. The underlying material probably consists of wind-laid deposits.

The surface layer ranges from 15 to 42 inches in thickness. Thickness of the subsoil ranges between 25 and 40 inches. In some areas lime has accumulated in the lower part of the subsoil.

Brownfield soils have a thicker, more sandy surface layer than that of the Amarillo and Miles soils. Their subsoil is more clayey and is redder than that of the Tivoli soils. They have a more sandy surface layer and a more clayey subsoil than the Likes soils.

The Brownfield soils have low moisture-supplying capacity and natural fertility. They are highly susceptible to wind erosion and are therefore poorly suited to cultivation. Nearly all areas that were once cultivated are abandoned, and most of the acreage remains in range.

Brownfield fine sand (Br).—This soil is nearly level to gently rolling. Slopes average about 3 percent.

Most of the acreage is only slightly eroded, but a few small, included areas have lost much of their surface soil because of erosion. About 12 percent of the acreage mapped consists of Tivoli fine sand. Also included are minor areas of Amarillo loamy fine sand, 0 to 3 percent slopes, and Miles loamy fine sand, 0 to 3 percent slopes.

Brownfield fine sand absorbs water readily. If left unprotected, it is highly susceptible to wind erosion. As a result, a few sandy mounds have been formed in some areas. Seeding and establishment of adapted native grass are needed for control of wind erosion and to maintain fertility. (Capability unit VIe-5, dryland; Deep Sand range site)

Brownfield soils, severely eroded (Bs3).—These soils occupy mounds formed by shifting, loose sand. In about 40 percent of the area, all of the surface layer is gone and the subsoil is exposed. In about 45 percent of the area, sand has accumulated in mounds that range from 1 to 6 feet in height. The rest of the soils have profile characteristics typical of the series.

About 5 percent of the acreage mapped consists of Brownfield fine sand.

Nearly all of these Brownfield soils were cultivated at one time but then were abandoned and allowed to revegetate. In the vegetated areas, wind erosion is still common. Controlled grazing is needed to maintain a cover of grass for control of blowing. (Capability unit VIe-5, dryland; Deep Sand range site)

Drake Series

The Drake series consists of moderately deep, limy, grayish-brown soils of the upland. These soils are gently sloping to moderately sloping and occupy areas along the eastern edge of basins in playas. They are in the west-central part of the county.

The surface layer is granular, grayish-brown or light brownish-gray clay loam about 8 inches thick. It is hard when dry but is friable when moist.

The subsoil is light brownish-gray clay loam about 22 inches thick. It is hard when dry, is friable when moist, and has prismatic and subangular blocky structure. The substratum is very pale brown loam or clay loam. This layer is at a depth of about 30 inches and contains much lime.

The surface layer ranges from 5 to 11 inches in thickness. The subsoil ranges from 11 to 25 inches in thickness.

The Drake soils have a shallower, more limy surface layer than the Portales. They are grayer and contain less segregated lime than the Mansker soils.

The Drake soils are well drained but are low in natural fertility. They absorb moisture readily and have moderate water-holding capacity. If not protected, these soils are highly susceptible to wind and water erosion.

Drake clay loam, 1 to 3 percent slopes (DcB).—This soil has gentle, convex slopes that average about 2 percent.

Nearly 4 percent of the acreage mapped consists of small areas of Portales loam, 1 to 3 percent slopes; Mansker loam, 1 to 3 percent slopes; and Drake clay loam, 3 to 5 percent slopes.

Most of Drake clay loam, 1 to 3 percent slopes, is cultivated; the main crops are cotton and grain sorghum. Because of cultivation, in some areas part of the clay and silt in the plow layer has blown away, and the upper 4 to 6 inches is now coarser than before cultivation. In places a few shallow rills have formed. Terracing and use of crop residue and fertilizer are needed to control wind and water erosion. These practices also help to conserve moisture and maintain fertility. (Capability unit IVes–1, dryland; capability unit IIIes–1, irrigated; High Lime range site)

Drake clay loam, 3 to 5 percent slopes (DcC).—This soil has slopes that average about 4 percent.

Nearly 6 percent of the acreage mapped consists of small areas of Portales fine sandy loam, 1 to 3 percent slopes; Mansker fine sandy loam, 3 to 5 percent slopes; and Drake clay loam, 1 to 3 percent slopes.

About all of Drake clay loam, 3 to 5 percent slopes, is in range. The few cultivated areas are used for grain sorghum. In some of these areas, the plow layer has been winnowed and is now fine sandy loam 4 to 5 inches thick. A few areas are cut by shallow gullies. Seeding and establishment of adapted native grass and controlled grazing are needed for control of runoff and erosion. (Capability unit VIe–3, dryland; High Lime range site)

Hilly Gravelly Land (Hg)

This land type consists of moderately sloping to steep areas on rounded knolls and low ridges, mostly in the southern part of the county. Slopes range from about 5 to 40 percent.

The soil material is reddish-brown to brown, is gravelly, and ranges from about 15 inches to many feet in thickness. In most places the gravelly material rests abruptly on red-bed sandstone, shale, or clay. In some areas, however, it is underlain by fine sand or loamy fine sand. The content of gravel in the soil ranges from about 20 to 80 percent. In many areas the gravel and sand are used commercially.

Range vegetation, consisting of mid and short grasses, uniformly covers this land type. (Capability unit VIs–1, dryland; Gravelly range site)

Likes Series

The Likes series consists of light-colored sandy soils of the upland. These soils are gently sloping to sloping. They are on alluvial fans and on foot slopes in the southeastern part of the county.

The surface layer is pale-brown to dark-brown, structureless loamy fine sand about 10 inches thick. It is loose when dry and moist.

The pale-brown subsoil to a depth of about 20 inches is structureless loamy fine sand. This layer is loose when dry and moist and contains some lime. The underlying material is very pale brown, loose fine sand and also contains some lime.

The surface layer ranges from 8 to 20 inches in thickness. In places this layer contains some lime.

The subsoil ranges from 10 to 28 inches in thickness and from fine sandy loam to very fine sand or loamy fine sand in texture.

The Likes soils have a less red surface layer than the Miles and Amarillo soils. They are more sandy than the Berthoud soils and are less sandy than the Tivoli soils. They have a more sandy subsoil than the Brownfield soils.

The Likes soils are well drained. Moisture and plant roots readily penetrate the surface layer and subsoil. These soils are low in available plant nutrients. They are used mainly for range.

Likes loamy fine sand (Lk).—This soil has complex, undulating slopes that average about 6 percent. It is on long, narrow ridges that are parallel to some of the major drainageways and streams.

Nearly 4 percent of the acreage mapped consists of small areas of Mansker fine sandy loam, 3 to 5 percent slopes; Berthoud fine sandy loam, 5 to 8 percent slopes; and Potter soils. These small inclusions do not affect use and management.

If left unprotected, this Like soil is highly susceptible to wind erosion. In some areas runoff from higher lying soils has cut a few deep gullies. Controlled grazing is needed to maintain a cover of grass for control of runoff and erosion. (Capability unit VIe–5, dryland; Sandy Land range site)

Loamy Alluvial Land (Lm)

This land type occupies areas along the flood plains of most rivers and streams in the county. The areas lie 2 to 8 feet below other surrounding soils and are flooded during periods of normal rainfall.

In some areas floodwater from higher, steep slopes deposits fresh material more than 1 inch thick after each rain. In a few areas the land type is not flooded but is so dissected by meandering stream channels that it is not suitable for cultivation.

The surface layer is reddish brown to very dark grayish brown. It ranges in texture from fine sandy loam or silt loam, to clay loam or clay. The subsoil contains layers of silt loam, very fine sandy loam, silty clay loam, clay loam, and clay.

Nearly all of this land type is in range that supports native mid and tall grasses. Unless the areas are protected

from flooding, cultivation is hazardous. (Capability unit Vw-1, dryland; Loamy Bottom Land range site)

Lofton Series

The Lofton series consists of deep, nearly level, grayish soils of the upland. These soils occupy small areas, generally above lakebeds in playas, throughout the High Plains part of the county. The native vegetation was short grass.

The surface layer is granular, pale-brown to dark grayish-brown fine sandy loam or clay loam about 6 inches thick. It is hard when dry but is friable when moist.

The subsoil is light-brown to dark grayish-brown clay about 28 inches thick. It has blocky structure, is extremely hard when dry, and is very firm when moist. The lower part contains lime. The underlying material is fine textured and contains much lime.

The surface layer contains lime in a few places. It ranges from 6 to 15 inches in thickness. The subsoil ranges from 20 to 52 inches in thickness.

The Lofton soils are browner than the Randall soils, and their surface layer contains less clay. They are darker to a greater depth than the Pullman soils and are in lower positions.

The Lofton soils have slow drainage. They are high in plant nutrients, but dry-farmed areas produce low yields because they are droughty.

Lofton clay loam (Ln).—This nearly level soil is on the first bench above playa lakebeds. In a few places the soil occupies smooth, concave areas not in the playa lakebeds.

Nearly 4 percent of the acreage mapped consists of narrow areas of Randall clay; Portales loam, 0 to 1 percent slopes; and Pullman silty clay loam, 0 to 1 percent slopes.

Nearly 50 percent of this Lofton soil is cultivated; the main crops are cotton, wheat, and grain sorghum. If this soil is cultivated, a hard crust forms readily on the surface; if it is not protected, the hazard of wind erosion is slight. Use of crop residue is needed to control erosion and maintain fertility. (Capability unit IIIce-1, dryland; capability unit IIs-1, irrigated; Deep Hardland range site)

Lofton fine sandy loam (Lp).—This soil is nearly level. It has concave slopes that average about 0.5 percent. The areas range from 5 to 20 acres in size.

Nearly 2 percent of the acreage mapped consists of Amarillo fine sandy loam, 0 to 1 percent slopes; Portales fine sandy loam, 0 to 1 percent slopes; and Zita fine sandy loam, 0 to 1 percent slopes.

If this Lofton soil is left unprotected, the hazard of wind erosion is slight. In places the plow layer has lost some silt and clay and is more sandy than before cultivation. Use of crop residue and fertilizer is needed to control blowing and maintain fertility. (Capability unit IIIe-4, dryland; capability unit IIe-4, irrigated; Sandy Loam range site)

Mansker Series

The Mansker series consists of dark, calcareous soils on the upland. These soils are nearly level to moderately sloping and occur throughout the county.

The surface layer is brown to dark grayish-brown fine sandy loam or loam about 7 inches thick. This layer is hard when dry but is very friable when moist. It contains some lime.

The subsoil is reddish-brown to grayish-brown clay loam about 10 inches thick. This layer has prismatic and granular structure. It is hard when dry but is friable when moist. It contains much segregated lime.

The substratum is old water-laid material that is reddish-yellow and contains much segregated lime. Figure 8 shows a profile of a Mansker soil.

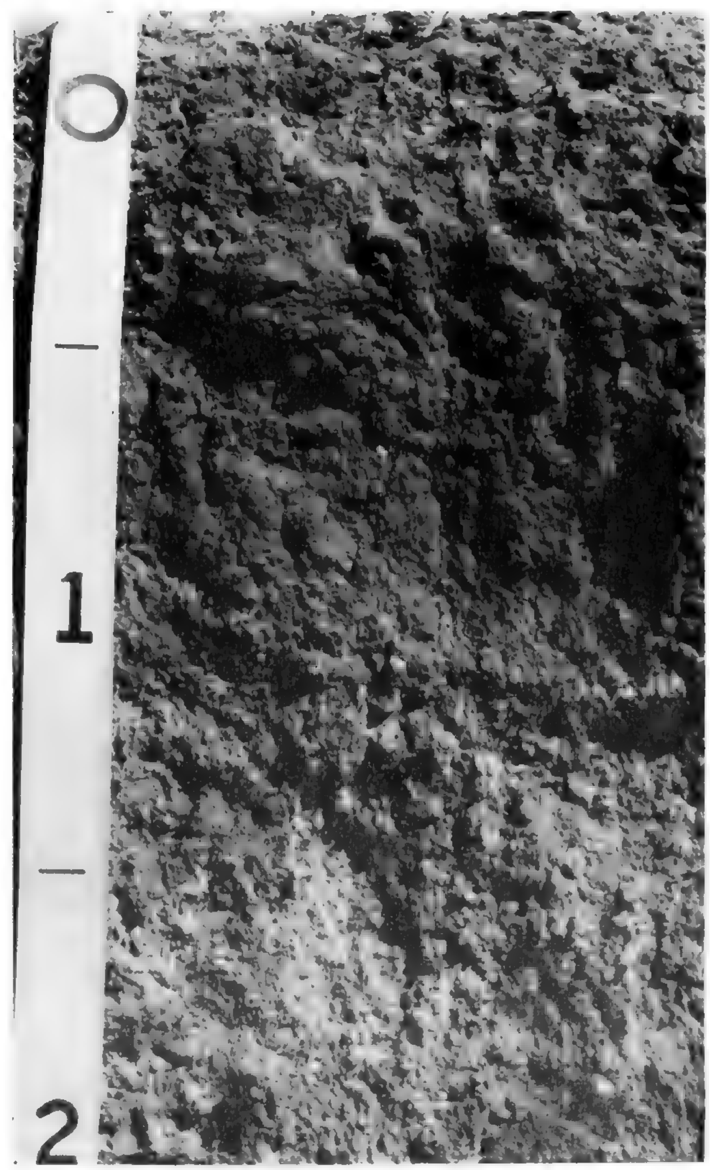


Figure 8.—**Profile of a Mansker fine sandy loam; the depth shown is about 2 feet.**

The surface layer ranges from 5 to 9 inches in thickness, and in places it lacks lime. The subsoil ranges from 6 to 14 inches in thickness.

The Mansker soils are 8 to 14 inches thicker than the Potter soils. They are shallower than the Portales, Amarillo, and Miles soils. Also, they contain more lime than the Amarillo and Miles.

The Mansker soils are well drained. They have moderate water-holding capacity and are low in natural fertility.

Mansker fine sandy loam, 0 to 1 percent slopes (MaA).—This nearly level soil is mostly in the southwestern part of the county. Slopes average about 0.5 percent.

In places as much as 2 percent of the acreage mapped consists of Portales fine sandy loam, 0 to 1 percent slopes; Amarillo fine sandy loam, 0 to 1 percent slopes; Potter soils; and Mansker fine sandy loam with slopes of more than 1 percent. A few areas are underlain by hard caliche.

Mansker fine sandy loam, 0 to 1 percent slopes, is moderately suited to irrigation farming but is poorly suited to dryland farming. Nearly all of the soil is cultivated and is mainly in grain sorghum and cotton. If left unprotected, the soil is moderately susceptible to wind erosion. In places part of the silt and clay has been blown from the plow layer, and this layer is now more sandy than before cultivation. Use of crop residue and fertilizer is needed to control blowing and maintain fertility. (Capability unit IVe–6, dryland; capability unit IIIe–8, irrigated; Sandy Loam range site)

Mansker fine sandy loam, 1 to 3 percent slopes (MaB).—This soil has gentle slopes that average about 2 percent. It occurs in small areas scattered throughout the county. In places the surface layer is only 4 to 5 inches thick.

About 3 percent of the acreage mapped consists of Portales fine sandy loam, 1 to 3 percent slopes; Amarillo fine sandy loam, 1 to 3 percent slopes; Miles fine sandy loam, 1 to 3 percent slopes; Berthoud fine sandy loam, 1 to 3 percent slopes; and Potter soils.

Most of this Mansker soil is cultivated, but the soil is poorly suited to dryland farming. The main crops are grain sorghum and cotton. In unprotected areas the hazard of wind erosion is moderate and that of water erosion is slight. In a few places silt and clay have been blown from the plow layer, and this layer is more sandy than before cultivation. In some areas water erosion has cut a few shallow gullies. Terracing and use of crop residue and fertilizer are needed for control of wind and water erosion and to maintain fertility. (Capability unit IVe–6, dryland; capability unit IIIe–8, irrigated; Sandy Loam range site)

Mansker fine sandy loam, 3 to 5 percent slopes (MaC).—This soil has convex, moderate slopes that average about 4 percent. It is the most extensive soil in the Mansker series. The soil occurs throughout the county but is mostly in the southern part.

Small areas of Mansker fine sandy loam with slopes of more than 5 percent make up about 12 percent of the acreage mapped. In some places a shallow soil formed from grayish sandstone makes up as much as 6 percent of the acreage. Also included are minor areas of Miles fine sandy loam, Amarillo fine sandy loam, Berthoud fine sandy loam, and Potter soils.

Nearly all of Mansker fine sandy loam, 3 to 5 percent slopes, is in range. A few areas are cultivated but are poorly suited to farming. Most cultivated areas are used for supplemental feed crops. If left unprotected, this soil is moderately susceptible to wind and water erosion. Most areas are cut by a few shallow gullies. Controlled grazing is needed to maintain a grass cover that can control runoff and erosion. (Capability unit VIe–2, dryland; Sandy Loam range site)

Mansker loam, 0 to 1 percent slopes (MkA).—This nearly level soil is in the central part of the county on the High Plains. Slopes average about 0.5 percent.

Nearly 2 percent of the acreage mapped consists of Portales loam, 0 to 1 percent slopes; Olton loam, 0 to 1 percent slopes; and Potter soils.

Nearly 50 percent of this Mansker loam is cultivated, and the main crops are cotton and grain sorghum. This soil is moderately well suited to irrigation farming but is poorly suited to dryland farming. If it is not protected, the hazard of wind and water erosion is slight. Use of crop residue and fertilizer are needed for control of blowing and to maintain fertility. (Capability unit IVe–5, dryland; capability unit IIIe–8, irrigated; Mixed Plains range site)

Mansker loam, 1 to 3 percent slopes (MkB).—This soil has gentle, convex slopes that average about 1.8 percent. It is the most extensive of the Mansker loams in the county and occupies small areas throughout the High Plains.

As much as 3 percent of the acreage mapped consists of Portales loam, 1 to 3 percent slopes; Pullman silty clay loam, 1 to 3 percent slopes; Olton loam, 1 to 3 percent slopes; Mansker fine sandy loam, 1 to 3 percent slopes; and Potter soils.

Even though this Mansker loam is poorly suited to dryland farming, about one-half of the acreage is cultivated. The areas are mostly in cotton and grain sorghum. If left unprotected, this soil is slightly susceptible to water and wind erosion. In some areas a few small rills form during rains of high intensity, but after one or two cultivations, these are generally obliterated. Terracing and use of crop residue and fertilizer are needed for control of wind and water erosion. These practices also help to conserve moisture and maintain fertility. (Capability unit IVe–5, dryland; capability unit IIIe–8, irrigated; Mixed Plains range site)

Mansker loam, 3 to 5 percent slopes (MkC).—This soil has convex, moderate slopes that average about 4 percent. It occurs throughout the High Plains part of the county.

Nearly 4 percent of the acreage mapped consists of Pullman silty clay loam, 1 to 3 percent slopes; Olton loam, 1 to 3 percent slopes; Portales loam, 1 to 3 percent slopes; and Mansker loam, 1 to 3 percent slopes.

Most of Mansker loam, 3 to 5 percent slopes, is in range. It is poorly suited to cultivation; nevertheless, a few areas are used for grain sorghum. If the soil is left unprotected, it is subject to slight wind erosion and to moderate water erosion. In places there are a few shallow gullies that generally are 1 to 2 feet deep and 4 to 8 feet wide. Seeding and establishment of adapted native grasses are needed for the control of erosion. Controlled grazing helps to maintain a cover of grass that can control runoff and erosion. (Capability unit VIe-1, dryland; Mixed Plains range site)

Mansker-Potter complex (Ml).—This complex consists of about 55 percent Mansker fine sandy loam, 20 percent Potter soils, and 10 percent escarpment. The remainder is made up of Likes loamy fine sand, Miles loamy fine sand, Miles fine sandy loam, Berthoud fine sandy loam, Berthoud loam, Vernon clay loam, and Spur fine sandy loam.

Areas of this complex are in the Rolling Plains below and adjacent to the caprock escarpment. The landscape of this complex is shown in figure 9.

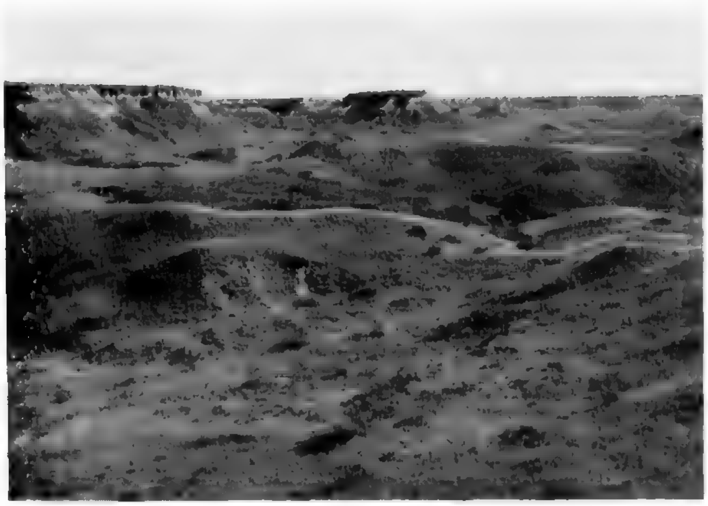


Figure 9.—**Landscape of the Mansker-Potter complex.**

The Mansker fine sandy loam in this complex is in long, narrow areas along drainageways and draws and on convex ridges between knolls of the Potter soils. Slopes average about 4 percent but range from 1 to 8 percent. Potter soils are on subrounded knolls and in sloping areas along small drainageways or gullies. Slopes average about 10 percent but range from about 1 to 30 percent. On the vertical caliche escarpment, enough soil material occurs between cracks and in crevices of the caliche to support some vegetation, but the escarpment is inaccessible to livestock.

This complex is used primarily for range. In areas where runoff accumulates, several gullies have formed. Controlled grazing is needed to maintain a cover of grass for control of runoff and erosion.

Typical Mansker and Potter soils are described under the separate series. (Mansker soil, capability unit VIe–2, dryland; Sandy Loam range site; Potter soil, capability unit VIIs–1, dryland; Very Shallow range site)

Miles Series

The Miles series consists of deep, brown to reddish-brown, well-drained soils of the upland. The soils are nearly level to moderately sloping and are mainly in the southern and eastern parts of the county.

In some places the surface layer to a depth of about 6 inches is brown to reddish-brown fine sandy loam. It is hard when dry but is very friable when moist. In other places this layer is loamy fine sand and on the average is about 14 inches thick. It is loose when dry and moist.

The subsoil is red to yellowish-red sandy clay loam and extends to a depth of about 45 inches. It has prismatic and subangular blocky structure. It is very hard when dry but is very friable when moist. The lower part becomes sandier and lighter in color as the depth increases.

The underlying material consists of old water-laid deposits or of plains outwash and is moderately sandy. Figure 10 shows a profile of Miles fine sandy loam.

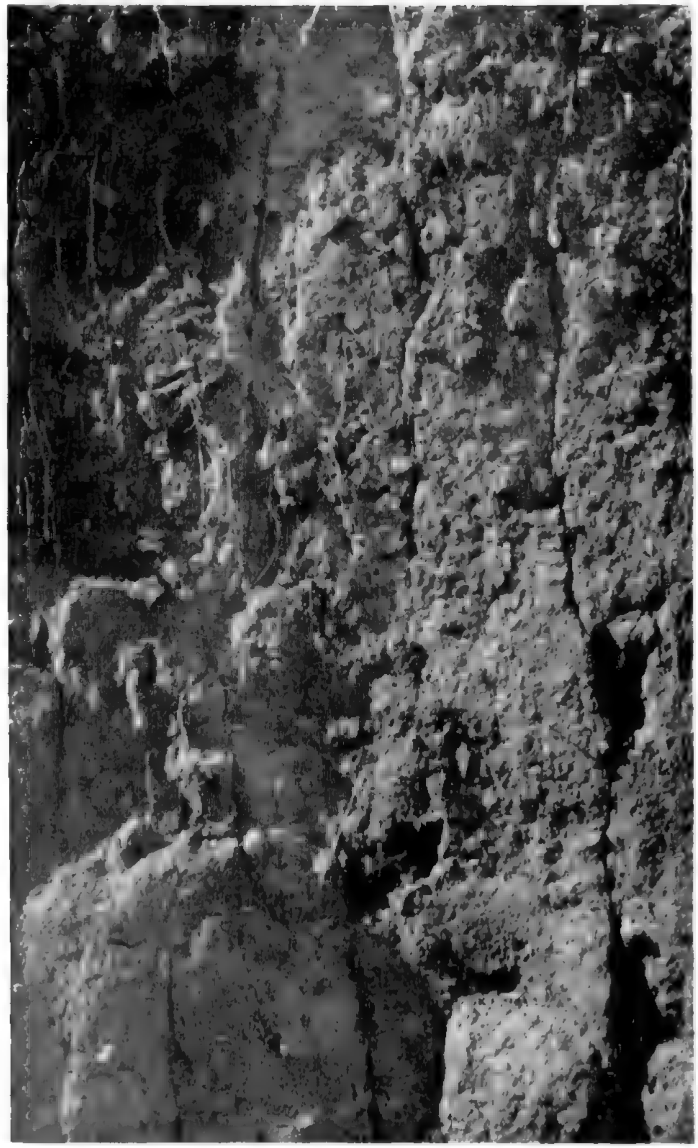


Figure 10.—**Profile of Miles fine sandy loam.**

The surface layer of the fine sandy loams ranges from 4 to 10 inches in thickness. That of the loamy fine sands ranges from 10 to 18 inches in thickness. Thickness of the subsoil ranges from 20 to 58 inches. In some places there is no lime.

The Miles soils are not so dark as the Abilene soils and have less clay in the subsoil. Their surface layer is not so sandy as that of the Brownfield soils

Most of the acreage of the Miles soils remains in grass, but these soils are among the better dryland soils in the county. Their moisture-supplying capacity is good, and they are well suited to most crops and grasses adapted to the area. The main cultivated crops are cotton and grain sorghum.

Miles fine sandy loam, 0 to 1 percent slopes (MnA).—This nearly level soil has slopes that average about 0.5 percent.

As much as 4 percent of the acreage mapped consists of included Miles fine sandy loam with slopes of more than

1 percent; Miles loamy fine sand, 0 to 3 percent slopes; and a few small areas of Randall clay.

This Miles soil absorbs most of the rain that falls and is desirable for farming. Nevertheless, most areas remain in range. If overgrazed or left unprotected, the soil is subject to moderate wind erosion. In a few cultivated areas, the surface layer has been winnowed and is now loamy fine sand. Use of crop residue and fertilizer are needed to control blowing and to maintain fertility. (Capability unit IIIe–4, dryland; capability unit IIe–4, irrigated; Sandy Loam range site)

Miles fine sandy loam, 1 to 3 percent slopes (MnB).—This is the dominant soil in the Miles series. It has gentle slopes that average about 1.8 percent. Most areas are along low ridges and divides between drainageways, rivers, or creeks.

Small areas of Miles fine sandy loam, 0 to 1 percent slopes, of Miles fine sandy loam, 3 to 5 percent slopes, of Mansker fine sandy loam, 1 to 3 percent slopes, and of Abilene clay loam, 1 to 3 percent slopes, make up about 10 percent of the mapped acreage.

Nearly all of Miles fine sandy loam, 1 to 3 percent slopes, remains in range. Cultivated areas are used for cotton and grain sorghum. In some of these areas, the surface layer is about 5 inches thick. In most cultivated areas the plow layer has been winnowed and is now loamy fine sand. If left unprotected, the soil is subject to moderate wind erosion and to slight water erosion. A few shallow gullies have been cut in some areas where the slopes are long and runoff concentrates. Terracing and use of crop residue and fertilizer are needed for control of wind and water erosion. These practices help to conserve moisture and maintain fertility. (Capability unit IIIe–4, dryland; capability unit IIe–6, irrigated; Sandy Loam range site)

Miles fine sandy loam, 3 to 5 percent slopes (MnC).—This soil has convex, moderate slopes that average about 4 percent. Most areas are on narrow ridges and foot slopes within larger areas of less sloping Miles soils. In most places the surface layer is about 4 inches thick.

Nearly 5 percent of the acreage mapped consists of Mansker fine sandy loam, 3 to 5 percent slopes; Berthoud fine sandy loam, 3 to 5 percent slopes; Potter soils; and Miles fine sandy loam, 1 to 3 percent slopes.

Nearly all of Miles fine sandy loam, 3 to 5 percent slopes, is in range. A few areas are cultivated and are used for supplemental feed crops. In some places runoff concentrates in low drainageways and forms gullies 1 to 4 feet deep and 4 to 10 feet across. Terracing and the use of crop residue and fertilizer are needed for control of wind and water erosion. These practices also help to conserve moisture and maintain fertility. (Capability unit IVe–2, dryland; Sandy Loam range site)

Miles loamy fine sand, 0 to 3 percent slopes (MmB).—This soil has gentle, convex slopes that average about 2 percent. It absorbs water readily and has little runoff, even after a heavy rain. The surface layer has a low capacity to hold moisture and plant nutrients. Except for a few small areas, most of the acreage has been used for cotton and grain sorghum.

Most of the acreage mapped is only slightly eroded, but a few small, included areas have lost most of their surface soil through erosion. About 4 percent of the acreage mapped is Miles fine sandy loam, 1 to 3 percent slopes, and Brownfield fine sand.

If left unprotected, Miles loamy fine sand, 0 to 3 percent slopes, is highly susceptible to blowing. As a result, a few small sandy mounds have formed in places. Also, along most fence rows there are accumulations of soil that are 1 to 6 feet thick. In some areas deep plowing to a depth of 14 to 22 inches has turned up the moderately fine textured subsoil, which forms clods for protection from blowing. Stubble mulching and use of crop residue and fertilizer are needed for control of blowing and to maintain fertility. (Capability unit IVe 4, dryland; capability unit, IIIe–7, irrigated; Sandy Land range site)

Miles loamy fine sand, 3 to 5 percent slopes (MmC).—This soil has convex, moderate slopes that average about 4 percent. It is along foot slopes below larger areas of the less sloping Miles loamy fine sand.

About 3 percent of the acreage mapped consists of Mansker fine sandy loam, 3 to 5 percent slopes; Brownfield fine sand; and Miles loamy fine sand, 0 to 3 percent slopes.

Nearly all of Miles loamy fine sand, 3 to 5 percent slopes, is used for range. If overgrazed or left unprotected, this soil is highly susceptible to wind erosion and is moderately susceptible to water erosion. In places where runoff concentrates, a few shallow gullies 1 to 3 feet deep have been cut. This soil is low in fertility but absorbs most of the rain that falls, even during periods of much rainfall. Controlled grazing is needed for maintaining a cover of grass that helps to control runoff and erosion. (Capability unit VIe–5, dryland; Sandy Land range site)

Olton Series

The Olton series consists of deep, dark-brown, well-drained soils of the upland. These soils are nearly level to gently sloping and are mostly in the west-central part of the county.

The surface layer is reddish-brown to dark-brown loam about 8 inches thick. It is hard when dry but friable when moist.

The subsoil to a depth of about 42 inches is reddish-brown to yellowish-red blocky clay loam. This layer is very hard when dry but is firm when moist. The lower part of the subsoil is less clayey and contains some lime.

The substratum is moderately fine textured and was probably deposited by wind. The upper part of this layer contains much lime. A profile of Olton loam is shown in figure 11.

The surface layer ranges from 6 to 9 inches in thickness. In some places it is clay loam. The subsoil ranges from 24 to 44 inches in thickness.

The Olton soils have more clay in the subsoil than the Amarillo soils. Also, their subsoil is redder and contains less clay than that of the Pullman and Lofton soils.

The Olton soils are well supplied with plant nutrients. They are well drained but absorb moisture slowly. Most of their acreage is used for irrigated cotton, grain sorghum, and wheat.

Olton loam, 0 to 1 percent slopes (OtA).—This soil is nearly level. Slopes average about 0.5 percent.

In places as much as 6 percent of the acreage mapped consists of Amarillo fine sandy loam, 0 to 1 percent slopes; Pullman silty clay loam, 0 to 1 percent slopes; and Zita

loam, 0 to 1 percent slopes. Also included are a few areas of Olton loam with slopes of more than 1 percent.

Olton loam, 0 to 1 percent slopes, tills easily and makes a good seedbed. If it is left unprotected, the hazard of wind erosion is slight. Use of crop residue and fertilizer is needed to control blowing and to maintain fertility. (Capability unit IIIce-2, dryland; capability unit IIe-1, irrigated; Deep Hardland range site)

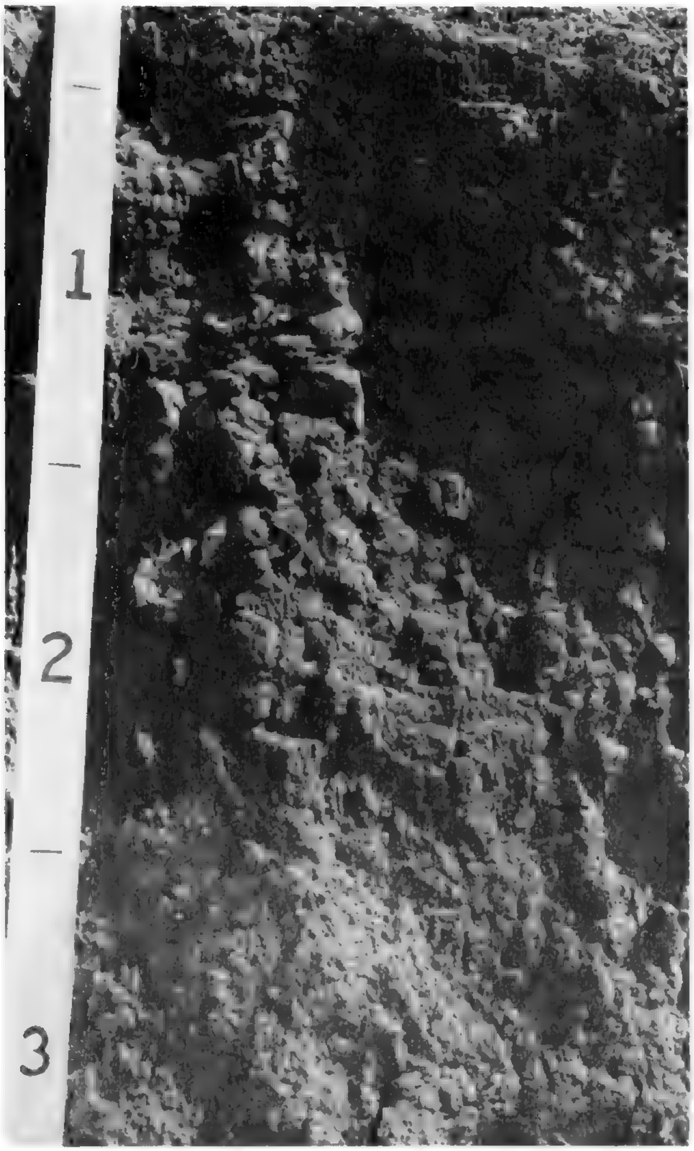


Figure 11.—**Profile of Olton loam; the depth shown is more than 3 feet.**

Olton loam, 1 to 3 percent slopes (OtB).—This soil has gentle slopes that average about 1.6 percent. It is mostly along the outer rims of playa basins throughout the west-central part of the county.

Nearly 3 percent of the acreage mapped consists of areas of Portales loam, 1 to 3 percent slopes; Amarillo fine sandy loam, 1 to 3 percent slopes; Mansker loam, 1 to 3 percent slopes; and Olton loam with slopes of less than 1 percent.

Olton loam, 1 to 3 percent slopes, tills easily and makes a good seedbed. If it is left unprotected, the hazard of water and wind erosion is slight. During rains of high intensity, a few shallow rills form, but most of them are obliterated after one or two cultivations. Terracing and use of crop residue and fertilizer are needed for control of wind and water erosion. These practices also help to conserve moisture and maintain fertility. (Capability unit IIIe-2, dryland; capability unit IIIe-2, irrigated; Deep Hardland range site)

Portales Series

The Portales series is made up of deep, dark, calcareous soils of the upland. These soils are nearly level to gently sloping. They are in concave areas surrounding playas throughout the west-central part of the county.

The surface layer is granular, brown to dark grayish-brown fine sandy loam or loam about 14 inches thick. It is hard when dry, is very friable when moist, and contains some lime.

The subsoil is yellowish-red to dark grayish-brown sandy clay loam about 18 inches thick. Its structure is prismatic and granular. The subsoil is hard when dry, is friable when moist, and contains more lime than the surface layer.

The substratum is moderately fine textured, wind-laid material that contains much lime.

The surface layer ranges from 7 to 22 inches in thickness. In some places it lacks lime. The subsoil ranges from loam to sandy clay loam or clay loam in texture and from 12 to 25 inches in thickness.

In contrast to the Zita soils, the Portales soils have lime in the surface layer. They contain less lime than the Drake soils and are deeper than the Mansker.

The Portales soils are well drained. They have a moderate capacity to store water and plant nutrients. Most of the soils are used for irrigated cotton and grain sorghum.

Portales fine sandy loam, 0 to 1 percent slopes (PfA).—This soil is nearly level. Slopes average about 0.5 percent.

As much as 4 percent of the acreage mapped consists of small areas of Mansker fine sandy loam, 0 to 1 percent slopes; Zita fine sandy loam, 0 to 1 percent slopes; Amarillo fine sandy loam, 0 to 1 percent slopes; and Portales loam, 0 to 1 percent slopes.

This Portales fine sandy loam is desirable for farming. It absorbs most of the rain that falls on it. If this soil is not protected, the hazard of wind erosion is moderate. In a few areas the plow layer has been winnowed and is now loamy fine sand. Use of crop residue and fertilizer is needed for control of blowing and to maintain fertility. (Capability unit IIIe-5, dryland; capability unit IIe-5, irrigated; Mixed Plains range site)

Portales fine sandy loam, 1 to 3 percent slopes (PfB).—This is a minor soil in the county. It has gentle slopes that average about 1.6 percent.

Nearly 5 percent of the acreage mapped consists of small areas of Mansker fine sandy loam, 1 to 3 percent slopes; Zita fine sandy loam, 0 to 1 percent slopes; and Portales fine sandy loam, 0 to 1 percent slopes.

Nearly all of Portales fine sandy loam, 1 to 3 percent slopes, is used for cotton and grain sorghum. The soil

is easy to cultivate but will blow and wash if left unprotected. Terracing and use of crop residue and fertilizer are needed for control of wind and water erosion. These practices also help to conserve moisture and maintain fertility. (Capability unit IIIe–5, dryland; capability unit IIIe–6, irrigated; Mixed Plains range site)

Portales loam, 0 to 1 percent slopes (PmA).—This soil is nearly level. Slopes average about 0.5 percent.

Nearly 3 percent of the acreage mapped consists of small areas of Zita loam, 0 to 1 percent slopes, and of Mansker loam, 0 to 1 percent slopes.

This Portales soil is well suited to both dryland and irrigation farming. It is well drained and is very friable. In addition, this soil is easy to till and makes a good seedbed. Because of lime in the surface layer, the hazard of wind erosion is moderate in unprotected areas. In places some of the silt and clay has been blown from the plow layer. As a result, this layer is now more sandy than before cultivation. Use of crop residue and fertilizer are needed for control of wind erosion and to maintain fertility. (Capability unit IIIe–5, dryland; capability unit IIe–3, irrigated; Mixed Plains range site)

Portales loam, 1 to 3 percent slopes (PmB).—This soil has gentle slopes that average about 1.8 percent.

About 5 percent of the acreage mapped consists of Mansker loam, 1 to 3 percent slopes; Zita loam, 1 to 3 percent slopes; Drake clay loam, 1 to 3 percent slopes; and Portales loam, 0 to 1 percent slopes.

Portales loam, 1 to 3 percent slopes, is well suited to cotton and grain sorghum. It is very friable and works into a good seedbed. In unprotected areas the hazard of water erosion is moderate, and that of wind erosion is slight. Terracing and use of crop residue and fertilizer are needed for control of wind and water erosion. These practices also help to conserve moisture and maintain fertility. (Capability unit IIIe–3, dryland; capability unit IIIe–4, irrigated; Mixed Plains range site)

Potter Series

The Potter series consists of very shallow, limy soils of the upland. The slopes are gentle to steep. Most areas are below the steep escarpment along the smooth plains. The native vegetation was short and mid grasses.

The surface layer is dark grayish-brown to reddish-brown, limy clay loam about 8 inches thick. It is hard when dry, friable when moist, and granular in structure. This layer grades abruptly to the underlying, partly cemented caliche.

The surface layer ranges from 4 to 10 inches in thickness. Its texture ranges from clay loam or loam to fine sandy loam.

The Potter soils are shallower than the Mansker soils. They are darker and less clayey than the Vernon soils.

The Potter soils are well drained. Since they are shallow, they have a low capacity to hold moisture and plant nutrients.

Potter soils (Ps).—These soils have gentle to steep slopes that average about 4 percent. They occupy narrow ridges, subrounded knolls, and steeply sloping areas along drains, mostly in the south-central part of the county.

In places as much as 12 percent of the acreage mapped consists of Mansker loam, 1 to 3 percent slopes, and of Mansker fine sandy loam, 1 to 3 percent slopes. A few areas of the Potter soils are underlain by soft caliche.

Nearly all of the Potter soils are in range. If these soils are left unprotected, the hazard of wind and water erosion is moderate. Controlled grazing is needed to maintain a cover of grass that can help control runoff and erosion. (Capability unit VIIs–1, dryland; Very Shallow range site)

Pullman Series

The Pullman series consists of deep, brown to dark grayish-brown soils of the upland. These soils are on broad, nearly level plains in the northern and northeastern parts of the county.

The surface layer is brown to dark grayish-brown, granular silty clay loam about 7 inches thick. It is hard when dry but friable when moist.

The subsoil to a depth of about 35 inches is reddish-brown to dark-brown, blocky clay. This layer is extremely hard when dry but firm when moist. The lower part contains some lime.

The substratum is moderately fine textured and was probably laid down by wind. The upper part contains much lime. Figure 12 shows a profile of a Pullman soil.

In some areas the surface layer is clay loam or loam that ranges from 5 to 9 inches in thickness. The subsoil ranges from 22 to 38 inches in thickness. Below the subsoil is an older buried soil in places.

The Pullman soils are less red than the Olton and have a more clayey subsoil. They somewhat resemble the Lofton soils, but those soils are on benches above playa basins.

The Pullman soils are well supplied with plant nutrients. They are well drained but absorb moisture very slowly. Most of the acreage is used for cotton, grain sorghum, and wheat. About 50 percent of the total acreage is irrigated.

Pullman silty clay loam, 0 to 1 percent slopes (PuA).—This soil is nearly level. Slopes average about 0.5 percent.

Nearly 4 percent of the acreage mapped consists of small, subrounded knolls of Olton loam, 0 to 1 percent slopes; small, circular areas of Lofton clay loam and Randall clay; and a few areas of Pullman silty clay loam, 1 to 3 percent slopes.

Pullman silty clay loam, 0 to 1 percent slopes, tills easily and makes a good seedbed. If left unprotected, this soil is subject to slight wind erosion. Use of crop residue and fertilizer is needed to control blowing and to maintain fertility. (Capability unit IIIce–1, dryland; capability unit IIs–1, irrigated; Deep Hardland range site)

Pullman silty clay loam, 1 to 3 percent slopes (PuB).—This soil has gentle slopes that average about 1.5 percent. It is mostly along the outer rim of playa basins scattered throughout the northern and northeastern part of the county.

In places as much as 3 percent of the acreage mapped consists of Olton loam, 1 to 3 percent slopes; Zita loam, 1 to 3 percent slopes; Mansker loam, 1 to 3 percent slopes; and a few areas of Pullman silty clay loam, 0 to 1 percent slopes. Pullman silty clay loam, 1 to 3 percent slopes, tills easily and works into a good seedbed. If left unprotected, the soil is subject to slight wind and water erosion.

Figure 12.—**Profile of Pullman clay loam.**

A few shallow rills form during rains of high intensity, but these are mostly obliterated after one or two cultivations. Terracing and use of crop residue and fertilizer are needed for control of wind and water erosion. These practices also help to conserve moisture and maintain fertility. (Capability unit IIIe–1, dryland; Capability unit IIIe–1, irrigated; Deep Hardland range site)

Randall Series

The Randall series consists of grayish soils that are on the floors of playas. These soils receive runoff from surrounding soils and are ponded for long periods. They are scattered throughout the county.

The surface layer is gray to dark grayish-brown clay or fine sandy loam about 25 inches thick. It is very hard when dry but is firm when moist.

The subsoil to a depth of about 52 inches is light-gray to dark-gray, blocky clay. It is extremely hard when dry, is very firm when moist, and contains some lime.

The substratum consists of gray, fine-textured material probably laid down by wind and water. This layer contains some lime.

The surface layer ranges from 5 to 30 inches in thickness. The subsoil ranges from 10 to 30 inches in thickness.

The Randall soils are grayer than the Lofton soils, and their surface layer generally contains more clay. They are grayer and more clayey than the Portales, Olton, and Amarillo soils.

These soils are high in plant nutrients. They have very slow drainage and are periodically wet, but they are droughty when dry. Consequently, yields of any crops that are harvested are low. During dry years these soils are susceptible to blowing if not protected.

Randall clay (Ra).—This soil is nearly level. It occupies concave areas below the smoother loamy plains. Because the clay shrinks and swells during wet and dry periods, the surface is slightly undulating.

About 4 percent of the acres mapped consists of Lofton clay loam; Zita loam, 0 to 1 percent slopes; Portales loam, 0 to 1 percent slopes; and Randall fine sandy loam.

Most areas of Randall clay are in range, but during dry seasons some areas have been used for grain sorghum and other forage. Bermudagrass has been sodded in a few areas. (Capability unit VIw–1, dryland; included in surrounding range sites)

Randall fine sandy loam (Rf).—This soil is nearly level. It occupies concave areas below the smoother, more sandy plains.

Included with the acreage mapped are small areas of Randall clay; Lofton fine sandy loam; and Zita fine sandy loam, 0 to 1 percent slopes.

Most of Randall fine sandy loam is used for cotton and grain sorghum, but during wet years crops are not harvested. If left unprotected, the soil is moderately susceptible to wind erosion. Use of crop residue and fertilizer is needed for control of blowing and to maintain fertility. (Capability unit IVw–1, dryland; included in surrounding range sites)

Rough Broken Land (Rm)

This miscellaneous land type consists of a thin layer of soil material over sandstone rock. The areas consist of very steep, precipitous walls or escarpments parallel to the White River. The slopes range from 20 to 150 percent.

About 15 percent of the acreage mapped consists of barren sandstone rock that occurs as outcrops. The areas are sloping to steep and are along the bottom of smaller tributaries of the White River. Between the sandstone outcrops are small areas of Likes and Berthoud soils that support tall and mid grasses. Also included with this land type is a narrow riverbed that makes up about 10 percent of the acreage mapped.

Along the steep escarpments are large sandstone boulders that have sloughed off the escarpments. Next to the boulders is a narrow band of colluvial and gravelly material that washed or rolled onto the areas and supports medium and tall grasses.

In most places there is a thin mantle of gravel and conglomerate rocks on the surface; however, this material

feathers out as the area grades to higher lying Berthoud, Mansker, Potter, and Miles soils. Tall and medium grasses grow in the gravelly mantle and in cracks and crevices between the rocks. (Capability unit VIIs-2, dryland; Rough Breaks range site)

Sandy Alluvial Land (Sa)

This land type lies along the flood plains of the major rivers in the county. It occupies areas that are as much as 2,000 feet wide and that are 2 to 10 feet above the river channels. Most of these areas are flooded during periods of normal rainfall, but a few areas are flooded only about once in 3 years.

In most places the surface layer is loamy fine sand, but in some it is fine sandy loam or fine sand. The subsoil is coarse-grained river sand. Free water generally is at a depth between 3 and 5 feet below the surface.

If left unprotected, Sandy alluvial land is highly susceptible to wind erosion. Cultivation is hazardous, unless the areas are protected from flooding.

The range vegetation consists of mostly little bluestem and sand bluestem. (Capability Unit Vw-2, dryland; Sandy Bottom Land range site)

Spur Series

The Spur series consists of deep, dark-colored, well-drained soils of the bottom land. These soils are nearly level and are in the southeastern part of the county.

The surface layer is brown to dark grayish-brown fine sandy loam or clay loam about 12 inches thick. It has granular structure, is hard when dry, and is very friable when moist. This layer contains some lime.

The subsoil to a depth of about 34 inches is brown to dark grayish-brown very fine sandy loam, loam, or clay loam. It has weak prismatic and granular structure. It is hard when dry, is very friable when moist, and contains some lime.

The substratum consists of stratified layers of alluvium that have a wide range in texture. This layer contains some lime.

The surface layer ranges from 5 to 26 inches in thickness. In some places this layer lacks lime. The subsoil ranges from 14 to 28 inches in thickness.

The Spur soils are in lower, less sloping positions than the Bippus soils and formed in more recent alluvium.

The Spur soils are among the best soils for farming in the county. They are generally well supplied with plant nutrients and can absorb a large amount of rainfall. The main cultivated crops are cotton and grain sorghum.

Spur clay loam (Sc).—This soil is nearly level. Slopes are about 0.6 percent.

About 4 percent of the acreage mapped consists of areas of Spur fine sandy loam; Abilene clay loam, 0 to 1 percent slopes; and Bippus clay loam, 1 to 3 percent slopes.

About 50 percent of Spur clay loam is used for cotton and grain sorghum. This soil is productive, tills easily, and works into a good seedbed. If left unprotected, it is slightly susceptible to wind erosion. Use of crop residue and fertilizer is needed to help control wind erosion and maintain fertility. (Capability unit IIce-1, dryland; capability unit I-1, irrigated; Loamy Bottom Land range site)

Spur fine sandy loam (Sf).—This nearly level soil occupies areas adjacent to most major streams in the county. Slopes average about 0.5 percent.

In places as much as 12 percent of the acreage mapped consists of Spur fine sandy loam with slopes of more than 1 percent. Also included are a few, small areas of Spur clay loam and Berthoud fine sandy loam, 1 to 3 percent slopes. In some areas the subsoil is fine sandy loam.

Most of Spur fine sandy loam is cultivated. If it is left unprotected, the hazard of wind erosion is moderate. Use of crop residue and fertilizer is needed to control wind erosion and maintain fertility. (Capability unit IIIe-4, dryland; capability unit I-2, irrigated; Loamy Bottom Land range site)

Stamford Series

The Stamford series consists of reddish, moderately deep soils of the upland. These soils are gently sloping and are in the eastern part of the county. The vegetation consists of tobosagrass.

The surface layer is reddish-brown to brown, blocky clay about 7 inches thick. It is extremely hard when dry but is extremely firm when moist. This layer contains some lime.

The subsoil to a depth of about 38 inches is reddish-brown to strong-brown clay. This layer is extremely hard when dry but is extremely firm when moist. It has blocky structure and contains some lime. The underlying material is reddish-brown clay from the red beds.

The surface layer ranges from clay loam to clay in texture and from 5 to 12 inches in thickness. The subsoil ranges from 25 to 40 inches in thickness.

The Stamford soils are deeper than the Vernon soils. The Stamford soils are droughty and absorb moisture very slowly. All of their acreage is used for range.

Stamford clay, 1 to 3 percent slopes (SmB).—This is a minor soil in the county. It occurs along gentle slopes that average about 1.3 percent. The areas are below steep ridges, generally adjacent to small drainageways.

Nearly 10 percent of the acreage mapped consists of small areas of Vernon clay loam, 1 to 3 percent slopes.

This Stamford soil is difficult to work and makes a poor seedbed. If the soil is left unprotected, it is subject to slight wind and water erosion. Use of crop residue is needed for control of erosion in cultivated areas. Controlled grazing is needed to maintain a cover of grass that can control runoff and erosion. (Capability unit IVe-8, dryland; Clay Flat range site)

Stamford soils, 0 to 1 percent slopes (StA).—These nearly level soils are adjacent to some of the major streams in the county. Slopes average about 0.5 percent. The surface layer ranges from fine to moderately fine in texture. A few areas have a salty surface layer and are not suitable for cultivation.

In places small areas of Bippus clay loam, 1 to 3 percent slopes, and of Berthoud fine sandy loam, 1 to 3 percent slopes, make up about 2 percent of the acreage mapped.

The Stamford soils work into a fair seedbed. When the soils are cultivated, however, a hard crust readily forms on the surface. If they are left unprotected, these soils are subject to slight wind and water erosion. Use of crop residue is needed for control of erosion and to main-

tain fertility. (Capability unit IIIs–1, dryland; Deep Hardland range site)

Tivoli Series

The Tivoli series consists of excessively drained, light-colored sandy soils of the upland. These soils occupy dunes adjacent to the White and Brazos Rivers, mostly in the southern part of the county. The vegetation consists of tall grass, sagebrush, and shin oak.

The surface layer is brown, loose fine sand that on the average is about 10 inches thick. This layer contains some lime.

The underlying material is coarse textured. It was probably blown on the upland from adjacent riverbeds and is generally several feet thick.

The surface layer ranges from 6 to 10 inches in thickness and in places lacks lime.

The Tivoli soils are more sandy throughout than the Likes, Brownfield, Amarillo, and Miles soils.

Tivoli soils absorb moisture very rapidly. They have a very low capacity to hold moisture and are also very low in plant nutrients. All of the acreage is used for range.

Tivoli fine sand (Tv).—This soil is a minor soil in the county. It is in dune areas, and slopes average about 15 percent. Some areas between the dunes have gentle slopes.

Nearly 4 percent of the acreage mapped consists of small areas of Sandy alluvial land.

This Tivoli soil is not suitable for cultivation because of its steep slopes and severe hazard of wind erosion. Controlled grazing is needed to maintain a cover of grass that can help control wind erosion. (Capability unit VIIe–1, dryland; Deep Sand range site)

Travessilla Series

The Travessilla series consists of very shallow, reddish-brown to grayish-brown soils of the upland. These soils are gently sloping to steep. Most areas are in the southern and southeastern parts of the county. The native vegetation was short and mid grasses.

The surface layer is grayish-brown to reddish-brown fine sandy loam about 3 inches thick. It has granular structure, is hard when dry, and is friable when moist. This layer grades abruptly to underlying indurated sandstone.

The surface layer ranges from 2 to 5 inches in thickness.

The Travessilla soils are more sandy than the Vernon. They contain less lime and are more sandy than the Potter soils.

The Travessilla soils are well drained. Because they are shallow, they have a low capacity to hold moisture and plant nutrients.

In Crosby County the Travessilla soils are mapped only in a complex with the Vernon soils.

Vernon Series

The Vernon series consists of reddish, shallow soils of the upland. These soils are widely scattered throughout the southern part of the county.

The surface layer is light-red to light-brown clay loam about 6 inches thick. It is very hard when dry, is friable when moist, and contains some lime.

If the subsoil is present, it is red to reddish-brown clay or clay loam as much as 14 inches thick. It has blocky structure and is extremely hard when dry and very firm when moist.

The underlying material is reddish-brown to olive-gray clay and shale from the red beds.

Variations in the thickness of the surface layer and subsoil occur within short distances. Generally, the surface layer ranges from 6 to 8 inches in thickness, mainly because of differences in degree of erosion. In some areas a distinct subsoil is lacking, but in others it ranges up to 14 inches in thickness.

The Vernon soils are shallower than the Stamford.

The Vernon soils are droughty and are generally low in organic matter and plant nutrients. They are used mainly for range.

Vernon clay loam, 1 to 3 percent slopes (VcB).—This soil is on low ridges and knolls between dissecting drainageways or creeks. It has gentle slopes that average about 2 percent. Most areas are long and narrow and are as much as 200 acres in size.

In some places about 12 percent of the acreage is made up of small, included areas of Abilene clay loam, 1 to 3 percent slopes; Mansker fine sandy loam, 1 to 3 percent slopes; Miles fine sandy loam, 1 to 3 percent slopes; and Stamford clay, 1 to 3 percent slopes.

This Vernon soil is used mainly for range. It is moderately susceptible to water erosion if not protected. A few shallow gullies occur along drainageways in some places. Grazing must be controlled to maintain a cover of grass that can control runoff and erosion. (Capability unit IVe–7, dryland; Shallow Redland range site)

Vernon clay loam, 3 to 15 percent slopes (VcD).—This soil is on subrounded knolls and ridges; slopes average about 8 percent. Generally, the areas are long and narrow and are parallel to small drains and creeks. A thin mantle of quartz pebbles is on the surface of some areas.

About 10 percent of the acreage mapped consists of areas of Mansker fine sandy loam, 3 to 5 percent slopes; Mansker loam, 3 to 5 percent slopes; Abilene clay loam, 1 to 3 percent slopes; Miles fine sandy loam, 3 to 5 percent slopes; Loamy alluvial land; and outcrops of sandstone and red beds.

If not protected, this soil is highly susceptible to water erosion. Most areas contain a few shallow gullies and rills 1 to 3 feet deep and 2 to 10 feet wide. Because of slope and high susceptibility to erosion, this soil is unsuitable for cultivation. Controlled grazing is needed to maintain a cover of grass for control of runoff and erosion. (Capability unit VIe–4, dryland; Shallow Redland range site)

Vernon-Travessilla complex (Vb).—This complex occurs as elongated secondary escarpments below the High Plains. It is throughout the southern and eastern parts of the county in areas that range from 250 to 600 feet in width.

About 64 percent of the acreage mapped consists of Vernon clay loam; 27 percent, Travessilla fine sandy loam; and the rest, sandstone bedrock and red-bed clay.

The Vernon soil of this complex has a rather smooth surface and generally lies along the mid and lower slopes of the escarpments. The slopes range from 8 to 65 per-

cent, but they average about 30 percent. A thin mantle of sandstone and siliceous gravel covers about 30 to 50 percent of the surface. The vegetation consists of sideoats grama, blue grama, buffalograss, and three-awn.

The Travessilla soil occurs as narrow catstep benches above the Vernon soil and as a narrow band that caps the escarpments. The slopes range from 3 to 15 percent but average about 8 percent. In most areas about 30 percent of the surface is covered by outcrops of sandstone bedrock and conglomerate, and the rest by a thin mantle of siliceous gravel. The Travessilla soil supports a cover of sideoats grama, blue grama, black grama, little bluestem, and three-awn.

The thickness of the sandstone bedrock and stones ranges from 1 to 8 feet. Red-bed clay occurs in eroded spots on the lower slopes of the Travessilla soil. The bedrock and red-bed clay are almost bare of vegetation. In places these materials make up 15 percent of the complex. Controlled grazing is needed to maintain a grass cover that helps to control water erosion. (Vernon soil, capability unit VIe 4, dryland; Shallow Redland range site; Travessilla soil, capability unit VIIs–1, dryland; Very Shallow range site)

Zita Series

The Zita series consists of deep, dark, well-drained, friable soils of the upland. These soils are nearly level to gently sloping and are in the western part of the county. Slopes are concave.

The surface layer is brown to very dark grayish-brown loam or fine sandy loam about 18 inches thick. This layer is hard when dry, is friable when moist, and has granular structure.

The subsoil is pale-brown to dark grayish-brown clay loam about 14 inches thick. It has compound weak, coarse, prismatic and weak, granular structure. It is very hard when dry, very friable when moist, and contains some lime.

The substratum is moderately fine textured, wind-laid material that contains much lime.

The surface layer ranges from 8 to 22 inches in thickness. In some places the surface layer contains some lime. The subsoil ranges from loam to sandy clay loam, or clay loam in texture, and from 6 to 30 inches in thickness.

Unlike the Portales soils, Zita soils have no lime in the surface layer.

The Zita soils are well drained and are high in fertility. Most of their acreage is used for irrigated cotton and grain sorghum.

Zita fine sandy loam, 0 to 1 percent slopes (ZfA).—This moderately coarse textured Zita soil is nearly level. Slopes average about 0.5 percent. It is a little lower in fertility than the loamy Zita soils.

In places as much as 10 percent of the acreage mapped consists of Amarillo fine sandy loam, 0 to 1 percent slopes; Portales fine sandy loam, 0 to 1 percent slopes; Lofton fine sandy loam; and Mansker fine sandy loam, 0 to 1 percent slopes.

This Zita soil is easy to cultivate and absorbs rainfall readily. If it is not protected, the hazard of wind erosion is moderate. In a few areas the plow layer has been winnowed and is more sandy than before it was cultivated. Use of crop residue and fertilizer is needed to control blowing and maintain fertility. (Capability unit IIIe–4, dryland; capability unit IIe–4, irrigated; Sandy Loam range site)

Zita loam, 0 to 1 percent slopes (ZmA).—This soil is nearly level. Slopes average about 0.5 percent.

Nearly 4 percent of the acreage mapped consists of small areas of Portales loam, 0 to 1 percent slopes; Amarillo fine sandy loam, 0 to 1 percent slopes; and Zita loam, 1 to 3 percent slopes.

Zita loam, 0 to 1 percent slopes, is well drained, easily tilled, and works into an excellent seedbed. It is one of the most productive soils in the county. It is well suited to all crops adapted to the area but is used mainly for cotton and grain sorghum. If left unprotected, this soil is subject to slight wind erosion. Use of crop residue and fertilizer is needed to help control blowing and maintain fertility. (Capability unit IIIce–2, dryland; capability unit IIe–2, irrigated; Deep Hardland range site)

Zita loam, 1 to 3 percent slopes (ZmB).—This soil has gentle slopes that average about 1.5 percent.

Nearly 3 percent of the acreage mapped consists of small areas of Portales loam, 1 to 3 percent slopes; Mansker loam, 1 to 3 percent slopes; and Zita loam, 0 to 1 percent slopes.

Zita loam, 1 to 3 percent slopes, is well suited to cotton and grain sorghum. It is very friable and works into a good seedbed. If left unprotected, this soil is subject to slight wind erosion and to moderate water erosion. Terracing and use of crop residue and fertilizer are needed for control of wind and water erosion. These practices also help to conserve moisture and maintain fertility. (Capability unit IIIe–2, dryland; capability unit IIIe–3, irrigated; Deep Hardland range site)

Use and Management of the Soils

In this section wind erosion and its control are discussed in relation to use and management of the soils. The system of capability classification used by the Soil Conservation Service is explained. Then general management and management by capability units for both dryland and irrigated soils are discussed. Following that, predicted yields for dryland and irrigated soils are given. Finally, the use and management of the soils for range and for engineering purposes are discussed.

Wind Erosion and Its Control

No farm in Crosby County is safe from the damage caused by high winds. Wind erosion, therefore, has a major influence on soil management. Effective control of erosion requires the cooperation of all farmers in an area, because soil blown from unprotected fields damages the soils on adjoining farms.

Effects of wind erosion.—The effects of wind erosion are serious and extensive. Many crops are lost, and soil fertility is greatly reduced. Also, traffic accidents are common during dust storms. Insects and weed seeds are blown far and wide, and fences, hedges, and shelterbelts are sometimes ruined. Duststorms are disagreeable or unbearable, both to farm families and to town and city people. The most serious effects of wind erosion are the loss of fine soil particles (silt, clay, and organic matter) that are gradually sorted and moved to distant places.

The wind acts like a sieve on soils. It leaves the coarse particles but removes the fine particles that enable a soil to furnish food to plants.

In sandy regions large dunes accumulate around windbreaks, fences, or farm homes (fig. 13). In cultivated fields dunes as much as 10 feet high are common along fence rows. In places abandoned fields have lost all of the thick sandy surface layer. Blowing of sterile sand from these fields to adjacent areas of more productive soils is particularly damaging.

Figure 13.—Wind erosion, showing sand piled on fence line.

Wind erosion has had the most drastic effects on loamy fine sands and fine sands. In cultivated areas farmers may have to roughen the surface of the sandier soils with tillage implements several times in a single season. Even a small rain, however, is likely to break up the clods; then the soil blows and drifts severely. Constant care and maximum use of crop residue are required to reduce erosion.

The finer textured soils (loams and clay loams) are least affected by wind erosion, because tillage generally roughens and clods them so that they can resist blowing. In most areas, however, winnowing by wind has removed enough of the organic matter, silt, and clay from the surface soil to make it coarser textured than when it was first cultivated. Thus, soils become more susceptible to erosion, have less capacity to hold water and plant nutrients, and are more likely to form plowpans.

The same effects of wind erosion also occur in most cultivated areas of fine sandy loams. If such soils are not protected, wind erosion removes most of the organic matter, silt, and clay from the plow layer. The remaining sandy layer lacks plant food and is highly susceptible to wind erosion. To offset these effects, farmers have plowed deeper to bring up the more clayey, underlying material. In many areas this process has been repeated so often that the surface layer, to a depth of 10 to 12 inches, probably has changed from fine sandy loam to loamy fine sand.

Rangeland also shows the effects of wind erosion. In some places the soil is shifted or removed by wind, but generally it is blown onto the rangeland from cultivated areas. In places 6 inches to 3 feet of sand covers several acres. In these areas good grasses are smothered and only weeds and brush grow.

One of the least noticeable, yet most damaging effects of wind erosion, is the blowing of clay and silt from cultivated land onto rangeland. Materials picked up by wind from cultivated areas are carried many miles before being deposited on rangeland in a mantle 1/8 to 1/2 inch thick. This mantle is almost impervious to water and thus increases runoff and water erosion. The good grasses are thus deprived of greatly needed moisture.

Evidence of the removal of plant nutrients by wind erosion (*2*) [1] is shown by the following comparisons. Samples of dust deposited on snow and ice in Iowa by a duststorm originating in the Texas-Oklahoma Panhandle early in 1937 were compared with samples from a small dune formed by the same wind at Dalhart, Tex. The dust contained about 10 times as much organic matter as the dune sand, 9 times as much nitrogen, 19 times as much phosphoric acid, and about 1½ times as much potash. Compared to soil material in a virgin soil near Dalhart, the dust contained more than 3 times as much nitrogen and organic matter, about 5 times as much phosphoric acid, and 1¼ times as much potash.

Types of wind erosion.—There are three main types of soil movement by wind (*3*). They are (1) floating, (2) bouncing, and (3) creeping. During a duststorm, soil floats in the air, and this is the type of movement that is generally noticed. The resulting bouncing of particles causes the other two types of movement. The particles that move in a series of short bounces are the size of very fine to medium sand, and they are moved directly by the wind. These particles, in turn, cause larger particles to creep along the surface as they strike them, or they detach, lift, and suspend in the air particles the size of clay and silt. The material moved by bouncing or creeping stays near its place of origin, but dust that is suspended in air may be blown hundreds of miles away.

Factors in wind erosion.—Soil cloddiness, surface roughness, and amount of crop residue on the surface are the three main factors that affect the susceptibility of soil to wind erosion. These factors are closely interrelated.

A clod the size of an alfalfa seed (0.84 millimeter) resists blowing. Clod formation is directly related to soil texture, and normally from 0 to 12 percent of the clods in sandy soils are large enough to resist wind erosion. The fine sandy loams have from 12 to 35 percent of these clods, but loams and clay loams average about 50 percent clods of nonerodible size. On the average, coarse-textured soils are more than 8 times more erodible than moderately coarse textured soils, and they are more than 40 times more erodible than medium and moderately fine textured soils.

Control of wind erosion.—Control of wind erosion depends on conserving the clay and organic matter in soils. When wind erosion occurs, eventually so much fine material is lost that there is no longer enough clay to produce clods.

The rougher the surface, the higher the wind needed to start soil blowing. Roughness of a field depends on the height, length, spacing, and type of vegetative cover.

[1] Italic numbers in parentheses refer to Literature Cited, p. 70.

It also depends on the size, shape, and spacing of clods, ridges, and ripples. For example, listing has long been depended on to help control soil blowing. The effectiveness of listing depends mainly on whether enough clay and moisture are in the soil to produce clods and on the amount of stalk or stubble left standing in the beds. It also depends on surface roughness produced by listing.

Residues from previous crops can be used to help control soil blowing. They help to slow down the wind at the ground surface. Standing stubble reduces wind force more than flattened stubble, and close-spaced stubble reduces it more than the same amount of wide-spaced stubble.

The best way to control wind erosion is by maintaining a vegetative cover or by properly managing crop residues. If adequate residues are not available, emergency tillage should be used to produce roughness and clods.

Some areas in Crosby County have been eroded to the extent that they are no longer cultivated. Unless wind erosion is controlled, many other soils will eventually erode to the same degree.

The soils in Crosby County have not been farmed long and are moderately high in fertility. Their fertility is likely to be depleted after longer use, however, if good management is not practiced. If fertility declines, yields would be reduced and erosion would increase.

In most soils in the county, the content of organic matter has steadily decreased under cultivation. During the long, hot days of summer the organic matter in the soils decays rapidly if there is enough moisture and if the soils are left without cover or are thinly covered. Loss of organic matter decreases the capacity of the soils to hold moisture and fertility, causes poor tilth, and reduces the rate of penetration of air and water. Applying cotton burs or growing cover crops are the main practices used for maintaining the content of organic matter in the surface layer of the soils.

Capability Groups of Soils

The capability classification is a grouping that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest groupings are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, indicates that the chief limitation is climate that is too cold or too dry.

Soils that have a slight to moderate hazard of wind erosion and a moderate limitation because of climate are in subclass *ce*. The subclass *ce* indicates that limitations of erosion and climate are about equal in importance to the safe use and management of the soils in the subclass.

In Class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it are subject to little or no erosion but have other limitations that restrict their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example, IIe–1 or IIIce–1.

Some of the soil complexes are classified in two or more capability units. For example, Mansker-Potter complex has a dual capability classification as follows: Mansker fine sandy loam is in Dryland capability unit VIe–2 and Potter soils is in Dryland capability unit VIIs–1.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

Management of Dryland Soils

This section first describes general practices needed for dryland soils. Then the dryland capability classes, subclasses, and capability units are listed and management by dryland capability units is discussed. Finally, predicted yields per acre of the principal dryland crops are given.

General management of dryland soils

The chief factors that determine the type of management needed on cropland in this county are the low rainfall, high winds, and the hazard of wind and water erosion. Management that conserves moisture, protects the soils from wind and water erosion, and maintains productivity is therefore needed.

Erosion and loss of organic matter are hazards of all soils farmed in the county. In many of the soils, plowpans are a problem. Also, some of the soils are shallow to parent material or contain a large amount of lime, which affects their use.

A discussion of some practices that are used on the soils in the county follows. These practices are referred to in the section "Management of Dryland Soils by Capability Units."

Use of crop residue.—Crop residue can be used as a mulch to improve the soils and to protect them against wind and water erosion. Protection is especially needed

in fall, winter, and early in spring. These are the seasons when blowing is greatest.

In Crosby County the crops that produce a large amount of residue for mulching are small grains, grain sorghum (fig. 14), soybeans, and various grasses and clovers. Residue returned to the soil from these crops helps to (1) maintain the content of organic matter, (2) improve tilth, (3) maintain good soil structure, and (4) keep the soil open and porous so that it can better absorb and retain moisture.

Figure 14.—**Stubble from grain sorghum makes an excellent mulch.**

Use of crop residue also slows runoff and thus helps in the control of water erosion. Water erosion generally is greatest on slopes of more than 2 percent, but it occurs wherever water collects and runs downslope. As a result, soil has been lost in many areas of farmland in the county. Much of this acreage is still farmed, but yields are lower and profits are therefore reduced. Runoff from local thunderstorms of medium to high intensity also results in flooding, leaching, and in places in accumulation of alkali.

Applying cotton burs.—Cotton burs are used to protect erodible soil that did not produce enough cover. They are also used to protect new terraces, freshly leveled land, waterways, and other bare areas. If burs are added to soils in poor physical condition, they help to improve tilth. The burs should be spread evenly over the surface to increase yields and to reduce erosion.

Cotton burs protect the surface soil from erosion by shielding it from the wind. Other helpful effects of burs are as follows: (1) They increase the infiltration rate; (2) reduce runoff; (3) return nitrogen, phosphorous, and potassium to the soil; and (4) improve the condition of the soil by adding organic matter.

Use of cover crops.—A cover crop is any close-growing crop grown when the major crop does not furnish adequate cover. Native or introduced grasses suited to the county are excellent cover crops. Austrian winter peas, sweetclover, and hairy vetch are suitable legumes for cover crops, and wheat, oats , barley, and rye are suitable small grains. A cover crop protects the soil from wind and water erosion. It also supplies organic matter and thus improves tilth, fertility, and biological activity.

Stripcropping.—In this system crops are grown in alternate strips (fig. 15), or bands at right angles to the slope of the land or the prevailing wind. These strips form vegetative barriers to wind and water erosion. Stripcropping helps to protect cotton from sandblasting during windstorms. It also protects the soil from wind erosion after harvest. The main crops grown in protective strips are grain and forage sorghums and tall-growing perennial grass. Cotton is the main crop grown in the areas that need to be protected by stripcropping.

Figure 15.—**Stripcropping.**

Deep plowing.—This practice is commonly used to protect highly erodible soils that have a sandy surface layer. It is used to bring some of the clayey subsoil to the surface and thus form more stable clods that can protect the soil from blowing (fig. 16).

Figure 16.—**Deep plowing of Amarillo loamy fine sand.**

Deep plowing is effective only where one-fourth to one third of the furrow slice is moderately fine textured material. After deep plowing, soil blowing can be further controlled by the combined use of crop residue, clods, and roughness. Deep plowing alone is not enough to protect the soil for a long time.

If the surface layer continues to blow after deep plowing, or the moderately fine textured material is not within the reach of the deep plow, the resulting surface material is more hazardous to handle than the original surface material.

Preventing plowpans.—After the soil has been plowed to the same depth for several years, or if heavy equipment has been used repeatedly, a plowpan forms in some of the soils (fig.17). The compacted soil in the plowpan retards root growth, keeps water from penetrating the soils, and makes the soils less productive. Effective methods of preventing plowpans are chiseling or plowing to a depth below the compacted area.

Figure 17.—A plowpan in a Miles fine sandy loam.

Pasture planting.—Because many areas of cultivated soil consist of steep, shallow, unstable, shifting sand, they are best suited to pasture. These areas are highly susceptible to erosion, and a permanent cover of native grass is the best method of control.

Wind and water erosion are less likely to occur if range or pasture is in good to excellent condition. On the other hand, areas where the native grass is sparse or weak from overgrazing erode readily, and in places so much soil has been blown or washed away that the plants seem to stand on pedestals.

Pastures can be established by seeding or sprigging suitable varieties of adapted grasses and legumes. Information on suitable varieties and methods of planting can be obtained from local representatives of the Soil Conservation Service or the county agent.

Terracing and contour farming.—These practices are used in Crosby County to hold water where it falls, to help control water erosion, and to remove surplus water from cropland. Protecting the soils by these practices conserves moisture needed for best yields in this area of low rainfall. Many farmers have reported that enough moisture was saved from one rain in spring to get one-half bale more of cotton on terraced land than that received on adjoining land that was not terraced.

Terracing consists of constructing an earth embankment or a series of ridges and channels across the slope at suitable intervals. Terraced fields should be farmed on the contour and parallel to the terrace. Contour farming is plowing, planting, and tilling across the slope. Farming in this way helps to maintain the terraces as well as to reduce runoff and to control erosion. If terracing is needed, local representatives of the Soil Conservation Service, or other qualified people, should be consulted.

Cropping systems.—Cropping systems are used in Crosby County to control soil erosion, to conserve soil moisture, and to maintain or improve soil productivity. Generally, a cash crop is grown, and after it is harvested the surface soil is protected from erosion by residue from the crops or by a growing crop.

In this county a cropping system for dryland farming is generally based on the three main crops—cotton, grain sorghum, and wheat. Under average farming, cotton depletes the soil because it returns little residue to the soil. Wheat and grain sorghum generally produce enough residue to protect the soil from wind erosion. The more sandy soils, however, require more residue crops in the rotation than the less sandy soils.

Some of the soils in the county are shallow to parent material or contain much lime. Crops tolerant of these conditions should be planted if such soils are cultivated, since the kinds of crops that can be grown are limited.

Management of dryland soils by capability units

In this section the capability classes, subclasses, and units for dryland farming are listed. Following the list, the soils of Crosby County are grouped in capability units, and the use and management of the soils in each unit are given.

Class I.—Soils that have few limitations that restrict their use. (There are no dryland soils in class I in Crosby County.)

Class II.—Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.

Subclass IIe.—Soils subject to moderate erosion if they are not protected.

Capability unit IIe-1.—Deep, well-drained, gently sloping clay loams that have a moderately fine textured subsoil.

Subclass IIce.—Soils that are limited by lack of effective rainfall and by slight wind erosion.

Capability unit IIce-1.—Deep, well-drained, nearly level clay loams of the bottom land.

Capability unit IIce-2.—Deep, well-drained, nearly level clay loams that have a moderately fine textured subsoil.

Class III.—Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

Subclass IIIe.—Soils subject to severe erosion if they are cultivated and not protected.

Capability unit IIIe-1.—Deep, gently sloping silty clay loams that have a firm, blocky subsoil.

Capability unit IIIe-2.—Deep, well-drained, gently sloping loams or clay loams that have a moderately fine textured subsoil.

Capability unit IIIe-3.—Deep, well-drained, gently sloping, calcareous loams that have a limy, moderately fine textured subsoil.

Capability unit IIIe-4.—Deep, well-drained, nearly level to gently sloping fine sandy loams that have a moderately fine textured subsoil.

Capability unit IIIe-5.—Deep, well-drained, nearly level to gently sloping, limy fine sandy loams and loams that have a moderately fine textured subsoil.

Capability unit IIIe-6.—Deep, well-drained, gently sloping fine sandy loams.

Subclass IIIce.—Soils that are droughty and that are subject to slight wind erosion if not protected.

Capability unit IIIce-1.—Deep, nearly level silty clay loams and clay loams that have a firm, blocky subsoil.

Capability unit IIIce-2.—Deep, well-drained, nearly level loams that have a moderately fine textured subsoil.

Subclass IIIs.—Soils that have severe limitations of moisture capacity or tilth.

Capability unit IIIs-1.—Moderately deep, nearly level clay loams or clays that have a fine textured subsoil.

Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe.—Soils subject to very severe erosion if they are cultivated and not protected.

Capability unit IVe-1.—Deep, well-drained, moderately sloping loams that have a medium-textured subsoil.

Capability unit IVe-2.—Deep, well-drained, moderately sloping fine sandy loams that have a moderately fine textured subsoil.

Capability unit IVe-3.—Deep, well-drained, moderately sloping fine sandy loams that have a moderately coarse textured subsoil.

Capability unit IVe-4.—Deep, well-drained, nearly level to gently sloping loamy fine sands that have a moderately fine textured subsoil.

Capability unit IVe-5.—Moderately shallow, well-drained, nearly level to gently sloping loams.

Capability unit IVe-6.—Moderately shallow, well-drained, nearly level to gently sloping fine sandy loams.

Capability unit IVe-7.—Shallow, moderately well drained, gently sloping clay loams.

Capability unit IVe-8.—Moderately deep, poorly drained, gently sloping clays that have a fine-textured subsoil.

Subclass IVes.—Soils that are high in lime and that are subject to very severe erosion if they are cultivated and not protected.

Capability unit IVes-1.—Moderately deep, well-drained, gently sloping, limy clay loams.

Subclass IVw.—Soils that have very severe limitations for cultivation because of excess water.

Capability unit IVw-1.—Deep, poorly drained, nearly level fine sandy loams that have a blocky clay subsoil.

Class V.—Soils not likely to erode but that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Subclass Vw.—Soils too wet for cultivation; drainage or protection not feasible.

Capability unit Vw-1.—Deep, frequently flooded, loamy soils of the bottom land.

Capability unit Vw-2.—Deep, frequently flooded sandy soils of the bottom land.

Class VI.—Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass VIe.—Soils severely limited, chiefly by risk of erosion if protective cover is not maintained.

Capability unit VIe-1.—Deep and moderately shallow, well-drained, moderately sloping loams that have a medium or moderately fine textured subsoil.

Capability unit VIe-2.—Deep and moderately shallow, well-drained, moderately sloping fine sandy loams that have a subsoil of fine sandy loam or clay loam.

Capability unit VIe-3.—Moderately deep, well-drained, moderately sloping, limy clay loams.

Capability unit VIe-4.—Shallow, moderately sloping clay loams.

Capability unit VIe-5.—Deep, well-drained, moderately sloping loamy fine sands or fine sands.

Subclass VIw.—Soils severely limited by excess water and generally unsuitable for cultivation.

Capability unit VIw-1.—Deep, poorly drained, nearly level clays.

Subclass VIs.—Soils generally unsuitable for cultivation and limited for other uses by their moisture capacity, stones, or other features.

Capability unit VIs-1.—Shallow, moderately sloping to steep, gravelly soils.

Class VII.—Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation and that restrict their use largely to grazing, woodland, or wildlife.
- Subclass VIIe.—Soils very severely limited, chiefly by risk of erosion if protective cover is not maintained.
  - Capability unit VIIe-1.—Deep, moderately sloping to strongly sloping, sandy soils of the upland.
- Subclass VIIs.—Soils very severely limited by moisture capacity, stones, or other soil features.
  - Capability unit VIIs-1.—Very shallow, gently sloping to steep, loamy and calcareous soils.
  - Capability unit VIIs-2.—Rough broken land on steep slopes.

Class VIII.—Soils and landforms that, without major reclamation, have limitations that preclude their use for commercial production of plants and restrict their use to recreation, wildlife, or water supply or to esthetic purposes.
- Subclass VIIIs.—Rock or soil materials that have little potential for production of vegetation.
  - Capability unit VIIIs-1.—Sloping to steep, raw, clayey materials.

DRYLAND CAPABILITY UNIT IIe-1

Bippus clay loam, 1 to 3 percent slopes, is the only soil in this unit. It is a deep, well-drained, brown to dark grayish-brown, gently sloping soil that has a moderately fine textured subsoil.

This soil is fertile and has high capacity to hold moisture and plant nutrients. In addition, it works into a good seedbed and is fairly easy to cultivate. The chief hazards are slight wind erosion and moderate water erosion.

Nearly all of this soil is in range. In cultivated areas the main cash crops are cotton and grain sorghum, but wheat, barley, and other small grains are also grown.

A cropping system that helps to control erosion includes wheat, grain sorghum, or a similar residue crop for 1 year, and cotton, or another soil-depleting crop, for 1 year. Crop residue should be left on the surface to protect the soil from wind erosion and to conserve moisture. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs. Terracing and contour farming help to conserve moisture and to control water erosion.

DRYLAND CAPABILITY UNIT IIce-1

The only soil in this unit is Spur clay loam. It is a deep, well-drained, brown to dark grayish-brown, nearly level soil of the bottom land.

This soil is productive. During years of adequate rainfall, it produces high yields of tilled crops and of grasses. The soil tills easily and makes a good seedbed. A plowpan forms readily, however, if the soil is always plowed at the same depth. The chief hazards are lack of rainfall and slight wind erosion.

Cotton and grain sorghum are the main crops, but all crops adapted to the county can be grown.

A cropping system that helps to conserve moisture and to control wind erosion includes wheat, barley, rye, grain sorghum, or a similar residue crop for 1 year, and cotton, or some other soil-depleting crop, for 2 years. Crop residue should be left on the surface to protect the soil from wind erosion and to conserve moisture. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs. A plowpan can be prevented by varying the depth of tillage.

DRYLAND CAPABILITY UNIT IIce-2

Abilene clay loam, 0 to 1 percent slopes, is the only soil in this unit. It is a deep, well-drained, brown to dark grayish-brown, nearly level soil that has a moderately fine textured subsoil.

This soil is fertile and has high capacity to hold moisture and plant nutrients. It tills easily and works into a good seedbed. A plowpan forms readily, however, if the soil is always plowed at the same depth. The chief hazards are lack of sufficient rainfall and slight wind erosion.

Nearly all this soil is in range. In cultivated areas cotton and grain sorghum are the main cash crops, but wheat and other small grains are also grown.

A cropping system that includes wheat, grain sorghum, or a similar residue crop for 1 year, and cotton, or another soil-depleting crop, for 1 year helps to conserve moisture and to control wind erosion. Crop residue should be left on the surface to protect the soil from wind erosion and to conserve moisture. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs. Varying the depth of tillage helps to prevent formation of a plowpan.

DRYLAND CAPABILITY UNIT IIIe-1

Pullman silty clay loam, 1 to 3 percent slopes, is the only soil in this unit. It is a deep, brown to dark-brown, gently sloping soil that has a firm, blocky subsoil.

This soil is fertile and has high capacity to hold moisture and plant nutrients. Its subsoil is droughty, and water and plant roots move slowly through it. The soil is fairly easy to till and works into a fair seedbed. Slight wind erosion and moderate water erosion are the chief hazards.

The main cash crops are wheat and cotton; however, grain sorghum, barley, and oats are also grown.

A cropping system that includes wheat, grain sorghum, or a similar residue crop for 1 year, and cotton, or another soil-depleting crop, for 1 year helps to control wind and water erosion. Crop residue should be left on the surface to protect the soil from wind erosion and to conserve moisture. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs for the control of wind erosion. Terracing and contour farming help to conserve moisture and to control water erosion.

DRYLAND CAPABILITY UNIT IIIe-2

This unit consists of deep, well-drained, reddish-brown to dark grayish-brown, gently sloping soils. These soils have a moderately fine textured subsoil. The soils in this unit are—

Abilene clay loam 1 to 3 percent slopes.
Olton loam, 1 to 3 percent slopes.
Zita loam, 1 to 3 percent slopes.

These soils are fertile and have high capacity to hold moisture and plant nutrients. They work into a good

seedbed and are fairly easy to till. The chief hazards are slight wind erosion and moderate water erosion.

Nearly all of the Zita and Olton soils are cultivated. The Abilene soil, however, is used mostly for range. The main cash crops are cotton and grain sorghum, but wheat, barley, and other small grains are also grown.

A cropping system for control of erosion includes wheat, grain sorghum, or a similar residue crop for about 1 year, and cotton, or another soil-depleting crop, for 1 year. Crop residue should be left on the surface to help conserve moisture and protect the soil from erosion. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs. Terracing and contour farming help to conserve moisture and to control water erosion.

DRYLAND CAPABILITY UNIT IIIe-3

The only soil in this unit is Portales loam, 1 to 3 percent slopes. This is a deep, well-drained, dark grayish-brown, gently sloping calcareous soil. It has a limy, moderately fine textured subsoil.

Because the content of lime in the surface layer and subsoil is high in this soil, some plant nutrients are unavailable to plants. The sand-sized particles of lime also make the soil highly susceptible to wind erosion. This soil tills easily and makes a good seedbed, but if it is always plowed at the same depth, a plowpan forms readily. Moderate erosion by wind and water is the chief hazard.

Grain sorghum and cotton are the main cash crops. A cropping system that includes grain sorghum, or a similar residue crop, for about 1 year and cotton, or another soil-depleting crop, for 1 year helps to control erosion by wind and water. If stripcropping is done, strips of cotton should be alternated with grain sorghum. The strips should be moved to different parts of the field each year, so that all the field benefits from the sorghum residue. Leaving crop residue on the surface helps to protect the soil from blowing and to conserve moisture. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs. Terracing and contour farming help to conserve moisture and to control water erosion. Varying the depth of tillage helps to prevent formation of a plowpan. Yields would increase during years when rainfall is adequate if nitrogen and phosphate fertilizers were applied.

DRYLAND CAPABILITY UNIT IIIe-4

This unit consists of deep, well-drained, reddish-brown to dark grayish-brown, nearly level to gently sloping soils. These soils have a moderately fine textured subsoil. All of the soils but Spur fine sandy loam are in the upland. The soils in this unit are—

Amarillo fine sandy loam, 0 to 1 percent slopes.
Amarillo fine sandy loam, 1 to 3 percent slopes.
Lofton fine sandy loam.
Miles fine sandy loam, 0 to 1 percent slopes.
Miles fine sandy loam, 1 to 3 percent slopes.
Spur fine sandy loam.
Zita fine sandy loam, 0 to 1 percent slopes.

These soils are fertile and have moderate capacity to hold moisture and plant nutrients. They till easily and generally work into a good seedbed. A plowpan forms readily, however, if the soils are always plowed at the same depth. Moderate wind erosion is the chief hazard, but the gently sloping soils are also slightly susceptible to water erosion.

Nearly all of these soils are cultivated. Cotton and grain sorghum are the main cash crops.

A cropping system that helps to control erosion includes grain sorghum, or a similar residue crop, for about 2 years, and cotton, or another soil-depleting crop, for 1 year. Crop residue should be left on the surface to protect the soil from wind erosion and to conserve moisture. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs. Terracing and contour farming help to conserve moisture and control water erosion. Varying the depth of plowing helps to prevent formation of a plowpan.

DRYLAND CAPABILITY UNIT IIIe-5

In this unit are deep, well-drained, nearly level to gently sloping, limy soils of the upland. These soils are dark to dark grayish brown and have a moderately fine textured subsoil. The soils in this unit are—

Portales fine sandy loam, 0 to 1 percent slopes.
Portales fine sandy loam, 1 to 3 percent slopes.
Portales loam, 0 to 1 percent slopes.

These soils are only moderately productive. Because of the lime in the surface layer and subsoil, some nutrients in the soils, especially iron and phosphorus, are unavailable to plants. These soils till easily and generally make a good seedbed. A plowpan forms readily, however, if the soils are always plowed at the same depth. Wind erosion is the chief hazard. The gently sloping soils are also slightly susceptible to water erosion.

Most of the acreage of these soils is cultivated. The main cash crops are cotton and grain sorghum. Grain sorghum is susceptible to chlorosis, however, because of the large amount of lime in the soils.

A cropping system that helps to control wind and water erosion includes grain sorghum, or a similar residue crop, for about 2 years, and cotton, or another soil-depleting crop, for 1 year. If stripcropping is done, strips of cotton should be alternated with grain sorghum. Each year the strips should be moved to different parts of the field so that all the field benefits from the sorghum residue. Leaving crop residue on the surface helps to protect the soil from blowing and to conserve moisture. If not enough residue is produced, it may be necessary to use emergency tillage or to apply cotton burs. Terracing and contour farming help to conserve moisture and to control water erosion. Varying the depth of plowing helps to prevent formation of a plowpan.

DRYLAND CAPABILITY UNIT IIIe-6

Berthoud fine sandy loam, 1 to 3 percent slopes, is the only soil in this unit. It is a deep, well-drained, brown to pale-brown, gently sloping soil.

This soil is fertile and has moderate capacity to hold moisture and plant nutrients. It tills easily and generally works into a good seedbed; however, a plowpan forms readily if the soil is always plowed at the same depth. Moderate wind erosion and slight water erosion are the chief hazards.

Nearly all of this soil is cultivated; cotton and grain sorghum are the main cash crops.

A cropping system that helps to control erosion includes grain sorghum, or a similar residue crop for 2 years, and

cotton, or another soil-depleting crop, for 1 year. Crop residue should be left on the surface to help conserve moisture and to protect the soil from wind erosion. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs. Terracing and contour farming help to conserve moisture and to control water erosion. Varying the depth of plowing helps to prevent the formation of a plowpan.

DRYLAND CAPABILITY UNIT IIIce-1

This unit consists of deep, brown to very dark grayish-brown, nearly level soils that have a firm, blocky subsoil. The soils in this unit are—

Lofton clay loam.
Pullman silty clay loam, 0 to 1 percent slopes.

The soils in this unit are fertile and have high capacity to hold moisture and plant nutrients. Since the compact, blocky subsoil is slowly permeable to water and roots, these soils are droughty. They are easily tilled, but a plowpan forms readily if the soils are always plowed at the same depth. The chief hazards are lack of sufficient rainfall and slight wind erosion.

Cotton and wheat are the main cash crops, but grain sorghum, barley, and oats are also grown.

A cropping system that helps to control wind erosion and to conserve moisture includes wheat, grain sorghum, or a similar residue crop for 1 year, and cotton, or another soil-depleting crop, for 1 year. Crop residue should be left on the surface to protect the soil from wind erosion and to conserve moisture. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs. Terracing and contour farming help to conserve moisture. Varying the depth of tillage helps to prevent the formation of a plowpan.

DRYLAND CAPABILITY UNIT IIIce-2

This unit is made up of deep, well-drained, reddish-brown to dark grayish-brown, nearly level soils. These soils have a moderately fine textured subsoil. They are—

Olton loam, 0 to 1 percent slopes.
Zita loam, 0 to 1 percent slopes.

The soils in this unit are fertile and are well drained. They have high capacity to hold moisture and plant nutrients. They till easily and work into a good seedbed. A plowpan forms readily, however, if the soils are always plowed at the same depth. The chief hazards are lack of sufficient rainfall and slight wind erosion.

The main cash crops are cotton and grain sorghum, though wheat and other small grains are also grown.

A cropping system that includes grain sorghum or a similar residue crop for 1 year, and cotton, or another soil-depleting crop, for 1 year helps to conserve moisture and to control wind erosion. Crop residue should be left on the surface to help conserve moisture and control wind erosion. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs. Terracing and contour farming help to conserve moisture. Varying the depth of plowing helps to prevent formation of a plowpan.

DRYLAND CAPABILITY UNIT IIIs-1

The only soils in this unit are Stamford soils, 0 to 1 percent slopes. These soils are moderately deep, reddish-brown to brown, and nearly level clay loams or clays. They have a fine textured or moderately fine textured surface layer and a fine-textured subsoil.

The soils in this unit are poorly drained, but the capacity to hold moisture and plant nutrients is high. They are droughty because their fine-textured subsoil releases moisture slowly to plants. Water and plant roots move slowly through the compact, blocky subsoil.

All of the soils are in range. Some salty areas are not suited to cultivation. If the soils are cultivated, the chief hazards are droughtiness and slight wind erosion. A cropping system that includes barley, sudangrass, or similar crops that produce large amounts of residue should be used.

DRYLAND CAPABILITY UNIT IVe-1

The only soil in this unit is Berthoud loam, 3 to 5 percent slopes. This is a deep, well-drained, very pale brown to dark-brown, moderately sloping soil that has a medium-textured subsoil.

This soil is fertile. It has moderate capacity to hold moisture and plant nutrients. A few areas are used for sudangrass, oats, or similar supplemental feed crops. If the soil is cultivated, the chief hazard is moderate wind and water erosion.

This soil is best suited to grass, and nearly all of the acreage is in range. If the soil is cultivated, the cropping system should include sudangrass, oats, rye, barley, or similar crops that produce large amounts of residue. The residue should be left on the surface to help conserve moisture and to protect the soils from wind and water erosion. Where there is not enough residue to control wind erosion, it may be necessary to use emergency tillage or to apply cotton burs. Terracing and contour farming help to conserve moisture and to control water erosion.

DRYLAND CAPABILITY UNIT IVe-2

Miles fine sandy loam, 3 to 5 percent slopes, is the only soil in this unit. It is a deep, well-drained, brown to reddish-brown, moderately sloping soil that has a moderately fine textured subsoil.

The soil in this unit is fertile and has moderate capacity to hold moisture and plant nutrients. Moderate wind and water erosion is the chief hazard.

This soil is best suited to grass, and nearly all of the acreage is in range. A few cultivated areas are used for sudangrass, oats, or similar supplemental feed crops.

If this soil is cultivated, the cropping system should include sudangrass, oats, rye, barley, or similar crops that produce large amounts of residue. The crop residue should be left on the surface to protect the soil from wind and water erosion and to conserve moisture. If there is not enough residue to control wind erosion, it may be necessary to use emergency tillage or to apply cotton burs. Terracing and contour farming help to control water erosion and to conserve moisture.

DRYLAND CAPABILITY UNIT IVe-3

Berthoud fine sandy loam, 3 to 5 percent slopes, is the only soil in this unit. It is a deep, well-drained, brown, moderately sloping soil that has a moderately coarse textured subsoil.

The soil in this unit is moderately fertile. It has moderate capacity to hold moisture and plant nutrients. The chief hazard is moderate wind and water erosion.

This soil is best suited to grass, and most areas remain in range. A few areas, however, are used for sudangrass, oats, or similar supplemental feed crops.

If this soil is cultivated, the cropping system should include sudangrass, oats, rye, barley, or similar crops that produce large amounts of residue. The soil is high in lime, however, and sorghum is not profitable on it. Crop residue should be left on the surface to protect the soil from erosion and to conserve moisture. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs. Contour farming and terracing help to conserve moisture and to control water erosion.

DRYLAND CAPABILITY UNIT IVe-4

This unit consists of deep, well-drained, nearly level to gently sloping soils. These soils have a moderately fine textured subsoil. They are—

Amarillo loamy fine sand, 0 to 3 percent slopes.
Miles loamy fine sand, 0 to 3 percent slopes.

The soils in this unit absorb water readily. Runoff is slight, even after a heavy rain. These soils are generally low in organic matter and in available plant nutrients. The surface layer is also low in water-holding capacity and is loose and sandy; therefore, it is somewhat difficult to prepare a seedbed in these soils. High susceptibility to wind erosion is the chief hazard.

Nearly 50 percent of the acreage of these soils is cultivated. Grain sorghum and cotton are the main cash crops.

A cropping system that helps to control wind erosion includes grain sorghum, rye, or a similar residue crop for nearly 3 years and cotton, or another soil-depleting crop, for 1 year. If stripcropping is used, cotton strips should be alternated with grain sorghum. The strips should be moved to different areas of the field each year so that all the field can benefit from the sorghum residue. Crop residue should be left on the surface to protect the soil from wind erosion and to conserve moisture. If there is not enough residue, it may be necessary to use deep plowing or emergency tillage or to apply cotton burs.

DRYLAND CAPABILITY UNIT IVe-5

In this unit are moderately shallow, dark-colored, well-drained, nearly level to gently sloping soils. The soils in this unit are—

Mansker loam, 0 to 1 percent slopes.
Mansker loam, 1 to 3 percent slopes.

The soils in this unit have moderate capacity to hold moisture and plant nutrients. They till easily and generally work into a good seedbed. A plowpan forms readily if the soils are always plowed at the same depth. Limited capacity to store moisture and moderate wind and water erosion are the chief hazards.

About 60 percent of the acreage of these soils is cultivated. The chief cash crops are cotton and grain sorghum.

A cropping system that includes grain sorghum, rye, wheat, barley, or a similar residue crop for about 3 years, and cotton, or another soil-depleting crop, for 1 year helps to control wind and water erosion and to conserve moisture. If stripcropping is used, strips of cotton should be alternated with grain sorghum. Each year the strips should be moved to different parts of the field so that all the field benefits from the sorghum residue. Crop residue should be left on the surface to control wind erosion and to conserve moisture. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs. Terracing and contour farming help to conserve moisture and to control water erosion. Varying the depth of plowing helps to prevent formation of a plowpan.

DRYLAND CAPABILITY UNIT IVe-6

This unit consists of moderately shallow, dark-colored, well-drained, nearly level to gently sloping soils. The soils in this unit are—

Mansker fine sandy loam, 0 to 1 percent slopes.
Mansker fine sandy loam, 1 to 3 percent slopes.

The soils in this unit have moderate capacity to hold moisture and plant nutrients and are droughty. They till easily and make a good seedbed. A plowpan forms readily if the soils are always plowed at the same depth. The chief hazards are the limited moisture-holding capacity, moderate to severe wind erosion, and slight water erosion.

About 40 percent of the acreage of these soils is cultivated. Cotton and grain sorghum are the chief cash crops.

A cropping system that includes grain sorghum, rye, wheat, barley, or a similar residue crop for about 3 years, and cotton, or some other soil-depleting crop, for 1 year helps to control wind and water erosion and to conserve moisture. If stripcropping is done, the strips of cotton should be alternated with grain sorghum. Each year the strips should be moved to different parts of the field so that all the field benefits from the sorghum residue. Crop residue should be left on the surface to control wind erosion and to conserve moisture. If there is not enough residue, it may be necesary to apply cotton burs or to use emergency tillage. Terracing and contour farming help to conserve moisture and to control erosion. Varying the depth of plowing helps to prevent formation of a plowpan.

DRYLAND CAPABILITY UNIT IVe-7

Vernon clay loam, 1 to 3 percent slopes, is the only soil in this unit. It is a shallow, light-brown to reddish-brown, moderately well drained, gently sloping soil.

This soil is droughty and is low in fertility. Most areas remain in range, which is the best use for this soil. If the soil is cultivated, the chief hazards are droughtiness and moderate water erosion.

The cropping system should include sudangrass, oats, rye, barley, or similar crops that produce large amounts of residue. The residue should be left on the surface to conserve moisture and control wind erosion. Terracing and contour farming help to conserve moisture and to control water erosion.

DRYLAND CAPABILITY UNIT IVe-8

Stamford clay, 1 to 3 percent slopes, is the only soil in this unit. It is a moderately deep, poorly drained, reddish-brown to brown, gently sloping soil that has a fine-textured subsoil.

This soil has high capacity to hold moisture and plant nutrients. Water and plant roots move very slowly through the compact, blocky subsoil.

All of this soil remains in range. If the soil is cultivated, the chief hazards are droughtiness and slight water erosion.

A cropping system that includes oats, barley, sudangrass, or similar residue crops should be used. Leaving the crop residue on the surface helps to conserve moisture

and to control wind erosion. Terracing and contour farming help to conserve moisture and to control water erosion.

DRYLAND CAPABILITY UNIT IVes-1

Drake clay loam, 1 to 3 percent slopes, is the only soil in this unit. It is a moderately deep, grayish-brown to light brownish-gray, gently sloping soil of the upland and is high in lime.

This soil is well drained but is only moderately productive. The lime in the surface soil and subsoil keeps some of the plant nutrients in unavailable form. Most areas till easily and make a good seedbed. The chief hazards are severe wind erosion and moderate water erosion.

Nearly 50 percent of the acreage is cultivated; the main cash crops are cotton and grain sorghum.

A cropping system that helps to control wind and water erosion includes grain sorghum, or a similar residue crop for about 3 years, and cotton, or another soil-depleting crop, for 1 year. If stripcropping is used, strips of cotton should be alternated with grain sorghum. Each year the strips should be moved to different parts of the field, so that the entire field benefits from the sorghum residue. Crop residue left on the surface protects the soil from wind erosion and conserves moisture. If there is not enough residue, it may be necessary to use emergency tillage or to apply cotton burs. Terracing and contour farming help to conserve moisture and control water erosion.

DRYLAND CAPABILITY UNIT IVw-1

The only soil in this unit is Randall fine sandy loam. It is a deep, dark, poorly drained, nearly level soil of the lakebeds. It has a blocky clay subsoil.

This soil is moderately productive; however, water and plant roots move slowly through the blocky clay subsoil. Wetness during some periods and moderate wind erosion during dry periods are the chief hazards.

Most areas of this soil are cultivated; the main cash crops are cotton and grain sorghum.

Generally, the areas of this soil are so small that it is best to apply the same practices as those applied to adjoining areas.

DRYLAND CAPABILITY UNIT Vw-1

Loamy alluvial land is the only land type in this unit. It is a deep, frequently flooded, loamy soil of the bottom land.

This land type receives runoff from the surrounding, higher lying soils. It is subject to flooding, to scouring, and to deposition of fresh material. Consequently, it is not suitable for cultivation but should remain in range. Some areas are excellent sites for farm ponds.

Proper range management should include (1) maintaining a minimum of 50 percent of a season's growth of grass; (2) providing planned periods of deferred grazing to allow a vigorous growth of grass; and (3) controlling mesquite trees and other brush by chemical spraying, root plowing, or bulldozing.

This land type is in the Loamy Bottom Land range site, which is discussed in the section "Range Management."

DRYLAND CAPABILITY UNIT Vw-2

The only land type in this unit is Sandy alluvial land. It consists of deep, light-colored, frequently flooded soil of the bottom land.

This land type receives runoff from surrounding, higher lying soils. It is subject to flooding, to scouring, and to the deposition of fresh material.

If left unprotected, this land type is highly susceptible to wind erosion. Consequently, it is not suited to cultivation but should remain in range.

Proper range management should include (1) maintaining a minimum of 50 percent of a season's growth of grass; (2) providing planned periods of deferred grazing to allow a vigorous growth of grass; and (3) controlling sagebrush by shredding or chemical spraying.

This land type is in the Sandy Bottom Land range site, which is described in the section "Range Management."

DRYLAND CAPABILITY UNIT VIe-1

In this unit are deep and moderately shallow, well-drained, moderately sloping soils that have a medium or moderately fine textured subsoil. The soils in this unit are—

Berthoud loam, 5 to 8 percent slopes.
Mansker loam, 3 to 5 percent slopes.

These soils are moderately fertile and have moderate capacity to hold moisture. The Mansker soil is moderately shallow and is therefore somewhat droughty. Because of their moderate slope, these soils are highly susceptible to water erosion and are not suited to cultivation.

Range management for the control of water erosion and to conserve moisture should include (1) maintaining a minimum of 50 percent of a season's growth of grass; (2) providing planned periods of deferred grazing to allow a vigorous growth of grass; and (3) controlling brush such as mesquite trees by chemical spraying, root plowing, or bulldozing.

The Berthoud soil is in the Deep Hardland range site, and the Mansker soil is in the Mixed Plains range site, which are described in the section "Range Management."

DRYLAND CAPABILITY UNIT VIe-2

This unit consists of deep and moderately shallow, well-drained, moderately sloping soils that have a subsoil of fine sandy loam or clay loam. The soils in this unit are—

Berthoud fine sandy loam, 5 to 8 percent slopes.
Mansker fine sandy loam, 3 to 5 percent slopes.
Mansker-Potter complex (Mansker soil only).

These soils are moderately fertile and have moderate water-holding capacity. If they have an adequate cover of plants, they absorb rainfall readily. The Mansker soils are moderately shallow and are therefore somewhat droughty.

Nearly all the acreage of the soils in this unit remains in range, which is the best use for the soils. If left unprotected, the hazard of water erosion is high and that of wind erosion is moderate.

Range management for the control of wind and water erosion and to conserve moisture should include (1) reseeding cultivated soil to native grass; (2) providing planned periods of deferred grazing to allow a vigorous growth of grass; and (3) controlling mesquite trees and similar brush by chemical spraying, root plowing, or bulldozing.

The soils in this unit are in the Sandy Loam range site, which is described in the section "Range Management."

765-184—65——3

DRYLAND CAPABILITY UNIT VIe-3

The only soil in this unit is Drake clay loam, 3 to 5 percent slopes. It is a moderately deep, well-drained, moderately sloping, limy soil of the upland.

This soil is only moderately fertile. The lime in the surface soil and subsoil keeps some of the plant nutrients unavailable. If the plant cover is adequate, this soil absorbs rainfall readily. Most areas remain in range, which is the best use. If left unprotected, the soil is highly susceptible to erosion by wind and water.

Range management for the control of wind and water erosion and to conserve moisture should include (1) reseeding any cultivated land to native grass; and (2) providing planned periods of deferred grazing to allow a vigorous growth of grass.

This soil is in the High Lime range site, which is discussed in the section "Range Management."

DRYLAND CAPABILITY UNIT VIe-4

This unit consists of shallow, reddish-brown, moderately sloping soils. The soils in this unit are—

- Vernon clay loam, 3 to 15 percent slopes.
- Vernon-Travessilla complex (Vernon soil only).

These soils are shallow and have low capacity for holding moisture and plant nutrients. If left unprotected, they are highly susceptible to water erosion. Because of these hazards, the soils are not suitable for cultivation.

Most areas of these soils remain in range. In most places the soils are suitable for farm ponds, especially along shallow drainageways.

Range management for the control of water erosion and to conserve moisture, should include (1) providing planned periods of deferred grazing to allow a vigorous growth of grass; and (2) maintaining a minimum of nearly 50 percent of the season's growth of grass.

The soils in this unit are in the Shallow Redland range site, which is in the section "Range Management."

DRYLAND CAPABILITY UNIT VIe-5

This unit consists of deep, pale-brown to brown, well-drained, moderately sloping soils. The soils in this unit are—

- Brownfield fine sand.
- Brownfield soils, severely eroded.
- Likes loamy fine sand.
- Miles loamy fine sand, 3 to 5 percent slopes.

These sandy soils absorb most of the rain that falls on them. Their capacity to hold moisture and plant nutrients, however, is low. If left unprotected, the soils are highly susceptible to wind erosion. If cultivated, the Miles soil is highly susceptible to erosion by water.

These soils remain mostly in range. Range management that helps control wind and water erosion and conserves moisture should include (1) maintaining a minimum of about 50 percent of the season's growth of grass; (2) providing planned periods of deferred grazing to allow a vigorous growth of grass; (3) controlling shin oak and sagebrush by shredding or chemical spraying; and (4) reseeding cultivated soil to native grass.

The Brownfield soils are in the Deep Sand range site, and the Likes and Miles soils are in the Sandy Land range site, which are described in the section "Range Management."

DRYLAND CAPABILITY UNIT VIw-1

The only soil in this unit is Randall clay. It is a deep, dark, poorly drained, nearly level soil.

This soil is in playa beds. It is flooded frequently by runoff from higher lying soils, which limits its use. The soil is only slightly subject to wind erosion. A few small, shallow lakes form during long, dry periods.

This soil is included in surrounding range sites because of the small size of the areas and the frequent floods.

DRYLAND CAPABILITY UNIT VIs-1

The only land type in this unit is Hilly gravelly land. It is shallow, moderately sloping to steep, and gravelly.

This land type is too gravelly and too steep for cultivation. If properly used, a fair cover of mid grass can be grown. Most areas are small and should be managed the same as surrounding range sites.

Proper range management should include (1) providing planned periods of deferred grazing to allow a suitable growth of grass; and (2) maintaining a minimum of about 50 percent of the season's growth of grass.

This land type is in the Gravelly range site, which is described in the section "Range Management."

DRYLAND CAPABILITY UNIT VIIe-1

Tivoli fine sand is the only soil in this unit. It is a deep, light-colored, moderately sloping to strongly sloping, sandy soil of the upland.

This soil is too sandy and too steep for cultivation. It is readily penetrated by moisture but has low moisture-holding capacity, and is also very low in plant nutrients. This soil is very highly susceptible to wind erosion if left unprotected.

Range management for the control of wind erosion and to conserve moisture should include (1) maintaining a minimum of about 50 percent of the season's growth of grass; (2) providing planned periods of deferred grazing to allow a suitable growth of grass; and (3) controlling sagebrush by shredding and controlling shin oak by chemical spraying.

The soil in this unit is in the Deep Sand range site, which is described in the section "Range Management."

DRYLAND CAPABILITY UNIT VIIs-1

This unit consists of very shallow, gently sloping to steep, loamy, calcareous soils. The soils in this unit are—

- Mansker-Potter complex (Potter soil only).
- Potter soils.
- Vernon-Travessilla complex (Travessilla soil only).

These soils are too steep and too shallow for cultivation. Their capacity to hold moisture and fertility is low. They have a fair cover of vegetation, but careful management is needed to control water erosion.

Range management for the control of water erosion and to conserve moisture should include (1) maintaining a minimum of about 50 percent of the season's growth of grass; and (2) providing planned periods of deferred grazing to allow a suitable growth of grass.

These soils are in the Very Shallow range site, which is described in the section "Range Management."

DRYLAND CAPABILITY UNIT VIIs-2

The land type Rough broken land is in this unit. It consists of steep, rough, broken areas.

This land type is too steep and too shallow for cultivation. Its capacity to hold moisture and fertility is low. Because the risk of water erosion is very high, this land type needs careful range management.

Range management for the control of water erosion and to conserve moisture should include (1) maintaining a minimum of about 50 percent of a season's growth of grass; and (2) providing planned periods of deferred grazing to allow a suitable growth of grass.

This land type is in the Rough Breaks range site, which is described in the section "Range Management."

DRYLAND CAPABILITY UNIT VIIIe-1

Only Badland is in this unit. It consists of sloping to steep, raw, clayey material from red beds.

This land type is suitable only for wildlife. Because it is highly erodible, it is extremely difficult to maintain a cover of vegetation on this land, even under very careful management. Some of the less sloping areas are suitable for pond sites.

Proper range management for the control of water erosion includes maintaining a maximum amount of a season's growth of grass.

This land type is not suitable for range and is therefore not classified in a range site.

Predicted dryland yields

In table 2 are predicted average yields per acre of the principal crops grown on dryland soils in Crosby County. The yields shown are those to be expected over a period of years and are for two levels of management.

In columns A are yields expected under a low level of management. The practices do not include use of a definite cropping system or the tillage needed to control wind erosion, and no particular effort is made to conserve water.

In columns B are yields to be expected under a high level of management. The practices applied under this level of management include (1) use of crop residue; (2) use of cover crops in the cropping system; (3) use of terracing and contour farming; (4) use of planned cropping systems; and (5) use of fertilizer. These and other practices are discussed in the section "General Management of Dryland Soils."

TABLE 2.—*Predicted average yields per acre for principal dryland crops under two levels of management*

[Yields in columns A are obtained at a low level of management; those in columns B are obtained at a high level of management. Soils not listed in this table are not suited to cultivation]

Soil	Cotton (lint)		Grain sorghum		Wheat	
	A	B	A	B	A	B
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Bu.*	*Bu.*
Abilene clay loam, 0 to 1 percent slopes	145	175	800	1,100	15	18
Abilene clay loam, 1 to 3 percent slopes	120	160	600	800	13	16
Amarillo fine sandy loam, 0 to 1 percent slopes	160	200	800	1,200	10	13
Amarillo fine sandy loam, 1 to 3 percent slopes	150	180	800	1,200	10	13
Amarillo loamy fine sand, 0 to 3 percent slopes	140	190	700	900	(1)	(1)
Berthoud fine sandy loam, 1 to 3 percent slopes	115	135	575	750	10	13
Berthoud fine sandy loam, 3 to 5 percent slopes	85	110	(1)	(1)	(1)	(1)
Berthoud loam, 3 to 5 percent slopes	80	105	(1)	(1)	(1)	(1)
Bippus clay loam, 1 to 3 percent slopes	110	130	550	750	12	15
Brownfield fine sand	60	90	300	400	(1)	(1)
Drake clay loam, 1 to 3 percent slopes	75	100	500	550	8	11
Lofton clay loam	135	170	800	1,100	14	17
Lofton fine sandy loam	170	210	800	1,200	11	14
Mansker fine sandy loam, 0 to 1 percent slopes	75	125	525	630	8	11
Mansker fine sandy loam, 1 to 3 percent slopes	65	120	515	610	8	11
Mansker fine sandy loam, 3 to 5 percent slopes	50	70	300	400	6	9
Mansker loam, 0 to 1 percent slopes	80	120	500	600	8	11
Mansker loam, 1 to 3 percent slopes	70	90	500	600	8	11
Mansker loam, 3 to 5 percent slopes	50	70	400	500	6	9
Miles fine sandy loam, 0 to 1 percent slopes	160	200	800	1,200	10	13
Miles fine sandy loam, 1 to 3 percent slopes	150	190	600	900	10	13
Miles fine sandy loam, 3 to 5 percent slopes	75	110	300	500	8	10
Miles loamy fine sand, 0 to 3 percent slopes	140	190	800	950	(1)	(1)
Olton loam, 0 to 1 percent slopes	145	175	800	1,100	15	18
Olton loam, 1 to 3 percent slopes	120	160	600	800	13	16
Portales fine sandy loam, 0 to 1 percent slopes	150	190	750	1,050	9	12
Portales fine sandy loam, 1 to 3 percent slopes	140	180	575	750	9	12
Portales loam, 0 to 1 percent slopes	145	185	700	900	11	15
Portales loam, 1 to 3 percent slopes	135	170	550	750	11	15
Pullman silty clay loam, 0 to 1 percent slopes	135	170	800	1,100	14	17
Pullman silty clay loam, 1 to 3 percent slopes	120	150	600	800	13	16
Randall fine sandy loam	145	185	750	1,000	(1)	(1)
Spur clay loam	150	200	800	1,200	15	18
Spur fine sandy loam	150	190	800	1,200	10	13
Zita fine sandy loam, 0 to 1 percent slopes	160	200	800	1,200	10	13
Zita loam, 0 to 1 percent slopes	160	200	800	1,200	15	18
Zita loam, 1 to 3 percent slopes	140	190	600	900	14	17

[1] The crop is not grown on this soil.

Management of Irrigated Soils

In this section the water supply of the county, methods of applying irrigation water, and the general management

of irrigated soils are discussed. Then the capability classes, subclasses, and units for irrigated farming are listed, and management by irrigated capability units is discussed.

Water supply.—In about 1935 the first irrigation well was drilled in the county, and irrigation farming began. Since then, the number of wells drilled increased yearly until in 1961, 1,877 had been drilled. The main source of irrigation water is from wells drilled into the Ogallala formation of Pliocene time. The wells produce between 100 and 600 gallons per minute. The depth to water ranges from 50 to 250 feet (*4*).

In 1935, 4 acres were irrigated in the county. According to the U.S. Census of Agriculture, 354,988 acres were irrigated in 1959 and 246,443 acres in 1954.

Many places in the High Plains have enough water available to irrigate crops. In most of this area, there is enough underground water to supply livestock. Here the water is at a depth of 100 to 200 feet. In the Rolling Plains, underground water is scarce, but enough water can be impounded to supply livestock.

Table 3 shows the yearly decline of irrigation water for wells in the counties adjoining Crosby County. It was estimated in 1958 that the Ogallala formation contained 7,913,000 acre-feet of water (*4*). During recent years the removal of water from the Ogallala formation has been faster than the recharge. It is estimated that if the supply of ground water is used for supplemental irrigation at a rate of 1 foot per year on one-fourth of the land in the county, the total supply of ground water should last 60 to 90 years (*4*).

TABLE 3.—*Yearly decline of irrigation water*

County and year	Number of wells	Average yearly decline
Floyd:		*Feet*
1938–41	35	1.5
1945–50	26	4.3
1950–55	43	5.2
1955–58	43	4.8
Lubbock:		
1938–41	33	.6
1945–50	31	1.7
1950–55	80	4.1
1955–58	74	3.4

Representative chemical analyses indicate that the quality of the water is good for irrigation. The water is low in sodium, magnesium, and similar salts, which are detrimental to soil and crops if used in sufficient quantity.

Cotton, grain sorghum, and wheat are the principal irrigated crops in the county. Some vegetable crops, mostly potatoes, onions (fig. 18), cucumbers, and tomatoes, have been irrigated in recent years.

Methods of irrigation.—In this county irrigation water is distributed mainly by flooding, by furrows, and under pressure from sprinklers. The system selected depends on the soil and its slope, the amount of water available, location of the well, and other factors. All systems have their advantages and disadvantages. A local representative of the Soil Conservation Service should be consulted about the kind of system needed for a specific farm.

Figure 18.—Harvesting onions grown in Olton loam.

Flooding is a method of irrigation that generally includes parallel borders (either level or graded), contour borders, and level or graded furrows.

In nearly level fields irrigation is done in parallel borders. Water is applied between these small parallel borders, or dikes, which divide the field into conveniently planned units. The level borders have no grade, but the graded ones are very gently sloping.

If the fields have gentle slopes, contour borders can be built. Areas that have contour borders are generally bench leveled on the contour.

Little border irrigation is practiced in Crosby County, because the wells do not deliver water in large enough quantities for this method.

Furrow irrigation is most widely used for irrgation in the county. In this system water is applied in furrows between rows of crops, or in furrows of various sizes and spacings. Soils of the Pullman, Olton, Zita, Portales, and Amarillo series can be furrow irrigated.

Sprinkler irrigation consists of conveying water to the field in pipelines and distributing it under pressure through a system of overhead nozzles or perforated pipes. Soils best suited to this system are the sandy Miles, Amarillo, and Brownfield.

General management of irrigated soils

The main practices used in management of irrigated soils are land leveling, conserving irrigation water, tillage, proper use of crop residue, applying cotton burs, use of cropping systems, and use of commercial fertilizer.

Land leveling.—Generally, land leveling is required before irrigation water can be uniformly distributed. Where water is applied by sprinkler, leveling may consist of only rough grading. Where level borders, graded furrows, or furrow irrigation is used, precise leveling may be needed. A detailed engineering plan is required for land leveling.

Conserving irrigation water.—This practice consists of applying irrigation water in the proper amount and at the time needed. It helps to obtain the most use from rainfall and to make the best use of available water without waste or significant erosion.

Proper tillage.—Irrigated fields need careful tillage. Most farmers find that some implements are not satisfac-

tory for tilling irrigated fields, because they leave the field rough and irregular. As a result, it is difficult to irrigate crops the next year. The best tools for most irrigated soils are a two-way moldboard plow, a double disk, a chisel, a sweep, and a lister.

Surface irregularities develop in most irrigated areas. Such irregularities should be observed during irrigation and places where more leveling is needed marked with stakes.

Use of crop residue.—In most irrigated areas, crop residue should remain on the soil throughout the period when blowing is critical, or until April 1. The residue should be well anchored before flooding or furrow irrigation is applied. If floating, planing, or more extensive leveling is needed, the residue should be turned under.

Applying cotton burs.—Cotton burs are applied on irrigated soils in about the same way as on dryland soils.

Cropping systems.—A cropping system on irrigated soil should include soil-improving crops as well as residue-producing crops and soil-depleting crops. The following practices are needed: (1) Growing of alfalfa, Madrid sweetclover, Hubam sweetclover, cowpeas, Austrian winter peas, mung beans, hairy vetch, and similar legumes; (2) using native and introduced grasses; and (3) fertilizing residue.

Cover crops are needed in cropping systems for irrigated soils and are used in about the same way as for dryland soils. They mainly help to improve the soil and protect it from wind erosion.

If soil-improving crops are used in the cropping system, they help maintain the content of organic matter. In addition, they make the soil more friable and help it to absorb more rainfall.

Legumes that can be grown for soil improvement include alfalfa, hairy vetch, soybeans, Austrian winter peas, and Madrid and Hubam sweetclovers. Also, grasses and fertilized residue from small grain and grain sorghum can be used to improve the soil. If the residue is properly fertilized, any small grain or sorghum that produces much residue can be used. About 20 to 40 pounds of nitrogen per acre is needed for 2,000 to 3,000 pounds of dry residue.

Native and introduced grasses adapted to the area are useful for soil improvement if a good stand is made for 2 or more years and a large amount of residue is returned to the soil.

Use of commercial fertilizer.—Although fertilizing irrigated soil is relatively new in Crosby County, the practice is generally accepted and is used by most farmers that irrigate their land. Most irrigated soils need nitrogen and phosphate fertilizers. The sandy soils and the soils that contain much lime also need potash. If fertilizer is properly used on irrigated cropland, cotton yields increase about half a bale per acre, and yields of grain sorghum increase about 2,000 to 3,000 pounds per acre.

Fertilizer should be placed so that it is best used by the crop grown. Because of the short growing season, part of the nitrogen and all of the phosphate should be applied before the crop is planted. The crop should be sidedressed with nitrogen at least once during the growing season.

The kind and amount of fertilizer used should be determined by soil tests. Also to be considered are the climate, the kind of soil, the crop to be grown, the crops previously grown, the amount of water available for irrigation, and many other factors.

Information on soil sampling and testing and use of commercial fertilizer can be obtained from local representatives of the Soil Conservation Service or from the county agent.

Management of irrigated soils by capability units

In this section the capability classes, subclasses, and units for irrigated farming are listed. Then the soils of this county are grouped in capability units, and the use and management of the soils in each unit are given.

Class I.—Soils that have few limitations that restrict their use.
- Capability unit I–1.—Deep, well-drained, nearly level clay loams of the bottom land.
- Capability unit I–2.—Deep, well-drained, nearly level loams of the bottom land.

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe.—Soils subject to moderate erosion if they are not protected.
  - Capability unit IIe–1.—Deep, well-drained, nearly level loams that have a slowly permeable, moderately fine textured subsoil.
  - Capability unit IIe–2.—Deep, well-drained, nearly level loams that have a permeable, fine-textured subsoil.
  - Capability unit IIe–3.—Deep, well-drained, nearly level, calcareous loams that have a permeable, moderately fine textured subsoil.
  - Capability unit IIe–4.—Deep, well-drained, nearly level fine sandy loams that have a permeable, moderately fine textured subsoil.
  - Capability unit IIe–5.—Deep, well-drained, nearly level, calcareous fine sandy loams that have a permeable, moderately fine textured subsoil.
  - Capability unit IIe–6.—Deep, well-drained, gently sloping fine sandy loams that have a permeable, moderately fine textured subsoil.
- Subclass IIs.—Soils that have moderate limitations of moisture capacity or tilth.
  - Capability unit IIs–1.—Deep, nearly level silty clay loams and clay loams that have a blocky, fine-textured subsoil.

Class III.—Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.
- Subclass IIIe.—Soils subject to severe erosion if they are cultivated and not protected.
  - Capability unit IIIe–1.—Deep, gently sloping silty clay loams that have a blocky, fine-textured subsoil.
  - Capability unit IIIe–2.—Deep, well-drained, gently sloping loams that have a slowly permeable, moderately fine textured subsoil.
  - Capability unit IIIe–3.—Deep, well-drained, gently sloping loams that have a permeable, moderately fine textured subsoil.
  - Capability unit IIIe–4.—Deep, well-drained, gently sloping, calcareous loams that have a permeable, moderately fine textured subsoil.

Capability unit IIIe-5.—Deep, well-drained, gently sloping fine sandy loams that have a permeable, moderately fine textured subsoil.

Capability unit IIIe-6.—Deep, well-drained, gently sloping, calcareous fine sandy loams that have a permeable, moderately fine textured subsoil.

Capability unit IIIe-7.—Deep, well-drained, nearly level to gently sloping loamy fine sands that have a moderately fine textured subsoil.

Capability unit IIIe-8.—Moderately shallow, well-drained, nearly level to gently sloping loams and fine sandy loams.

Subclass IIIes.—Soils that are high in lime and that are subject to severe erosion if they are cultivated and not protected.

Capability unit IIIes-1.—Moderately deep, well-drained, gently sloping, limy clay loams.

IRRIGATED CAPABILITY UNIT I-1

Spur clay loam is the only soil in this unit. It is a deep, well-drained, brown to dark grayish-brown, nearly level soil of the bottom land.

This soil is very productive. It is easily tilled, makes a good seedbed, and responds well to fertilizer. If continuously cropped, it becomes less fertile and loses its good tilth unless it is well managed. In many places there is a plowpan just below the plow layer. If left unprotected, the soil is slightly susceptible to wind erosion.

All tilled crops and grasses suited to the area can be grown on this soil, but the main crops are cotton and grain sorghum.

A cropping system that helps to control wind erosion and to maintain fertility and tilth is needed. A suitable cropping system is wheat, barley, rye, grain sorghum, or a similar residue crop for 1 year and cotton or some other soil-depleting crop for 2 years. Alfalfa, Hubam sweetclover, and winter peas are other residue crops that can be used in the cropping system. A good practice is to add nitrogen to crop residue to hasten decay of the residue. Varying the depth of tillage helps to reduce formation of a plowpan.

Furrow, border, or sprinkler irrigation can be used on this soil; however, land leveling is needed in places in most fields for proper distribution of irrigation water. In places commercial fertilizer is needed to help maintain high yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT I-2

The only soil in this unit is Spur fine sandy loam. It is a deep, well-drained, brown to dark grayish-brown, moderately coarse textured, nearly level soil of the bottom land.

The soil in this unit is moderately productive. It is easily tilled, makes a good seedbed, and responds well to fertilizer. If continuously cropped, it becomes less fertile and loses its good tilth unless it is well managed. A plowpan forms readily if the soil is always plowed at the same depth. If left unprotected, the soil is moderately susceptible to wind erosion.

The main cash crops are cotton and grain sorghum. A cropping system that helps to control wind erosion and to maintain fertility and tilth is needed. A suitable one is grain sorghum, wheat, rye, or a similar residue crop for 1 year and cotton or some other soil-depleting crop for 2 years. Other residue crops that can be used in the cropping system are alfalfa, Hubam sweetclover, and winter peas. A good practice is to add nitrogen to crop residue to hasten its decay. Varying the depth of tillage helps prevent the formation of a plowpan.

Sprinkler irrigation is the most desirable system. In some areas commercial fertilizer is needed to maintain high yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIe-1

The only soil in this unit is Olton loam, 0 to 1 percent slopes. It is a deep, well-drained, reddish-brown to dark-brown, nearly level soil with a slowly permeable, moderately fine textured subsoil.

This fertile soil has high capacity to hold moisture and plant nutrients. If continuously cropped, it becomes less fertile and loses its good tilth unless well managed. A plowpan forms readily if the soil is plowed at the same depth. If left unprotected, the soil is slightly susceptible to wind erosion.

Cotton and grain sorghum are the main cash crops, but wheat and other small grains are also grown.

A cropping system that helps to control wind erosion and to maintain fertility and tilth is needed. A suitable cropping system is grain sorghum, wheat, or another small grain for 1 year, and cotton or some other soil-depleting crop for 2 years. Alfalfa, Hubam sweetclover, and winter peas are other residue crops that can be used in the cropping system. If nitrogen is added to crop residue, it hastens decay of the residue. Varying the depth of tillage helps to prevent the formation of a plowpan.

Furrow, border, or sprinkler irrigation can be used on this soil. Land leveling is needed in places in most fields for proper distribution of irrigation water. In some areas commercial fertilizer is needed to help maintain yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIe-2

Zita loam, 0 to 1 percent slopes, is the only soil in this unit. It is a deep, well-drained, brown to dark grayish-brown, nearly level loam that has a permeable, fine-textured subsoil.

This soil is fertile and has high capacity to hold moisture and plant nutrients. It is easily tilled and works into a good seedbed. If continuously cropped, it becomes less fertile and loses its good tilth unless it is well managed. A plowpan forms readily if the soil is always plowed at the same depth. If left unprotected, the soil is slightly susceptible to wind erosion.

Grain sorghum and cotton are the main cash crops. A cropping system is needed that helps to maintain fertility and tilth and to control wind erosion. A suitable one is wheat, grain sorghum, or a similar residue crop for 1 year and cotton or some other soil-depleting crop for 2 years. Other residue-producing crops that can be used in the rotation are winter peas, alfalfa, and Hubam sweetclover. A good practice is to add nitrogen to the crop residue to hasten its decay. Varying the depth of tillage helps to prevent the formation of a plowpan.

Furrow, border, or sprinkler irrigation systems can be used on these soils. In some areas land leveling is needed for proper distribution of irrigation water. Commercial

fertilizer is needed in places to help maintain yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIe-3

The only soil in this unit is Portales loam, 0 to 1 percent slopes. It is a deep, well-drained, brown to dark grayish-brown, nearly level, calcareous soil of the upland. This soil has a permeable, moderately fine textured subsoil.

This soil is moderately productive. Its surface layer and subsoil contain lime that keeps many of the plant nutrients in unavailable form. This soil tills easily and makes a good seedbed. If it is always plowed at the same depth, however, a plowpan forms readily. If continuously cropped, this soil becomes less fertile and loses its good tilth unless it is well managed. Because the surface layer contains accumulated lime that is highly erodible by wind, this soil is moderately susceptible to wind erosion if left unprotected.

Cotton and grain sorghum are the main cash crops. A cropping system is needed that helps to control wind erosion and to maintain tilth and fertility. A suitable one is grain sorghum, wheat, or a similar residue crop for 1 year and cotton or some other soil-depleting crop for 1 year. Alfalfa, sweetclover, and winter peas are other residue crops that can be used in the cropping system. A good practice is to add nitrogen to crop residue to hasten its decay. Varying the depth of tillage helps prevent the formation of a plowpan.

Furrow, border, or sprinkler irrigation can be used. Land leveling is needed in places in some fields for proper distribution of irrigation water. In some commercial areas fertilizer is needed to help maintain high yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIe-4

This unit consists of deep, well-drained, reddish-brown to dark grayish-brown, nearly level soils. These soils have a permeable, moderately fine textured subsoil. The soils in this unit are—

Amarillo fine sandy loam, 0 to 1 percent slopes.
Lofton fine sandy loam.
Miles fine sandy loam, 0 to 1 percent slopes.
Zita fine sandy loam, 0 to 1 percent slopes.

The soils are fertile and have moderate capacity to hold moisture and plant nutrients. They till easily and generally work into a good seedbed. A plowpan forms readily if the soils are plowed at the same depth. If continuously cropped, the soils become less fertile and lose their good tilth. If left unprotected, they are moderately susceptible to wind erosion.

Cotton and grain sorghum are the main cash crops. A cropping system is needed that helps to control wind erosion and to maintain fertility and tilth. A suitable one is grain sorghum, wheat, or a similar residue crop for 1 year and cotton or some other soil-depleting crop for 2 years. Other residue crops that can be used in the rotation are alfalfa, Hubam sweetclover, or winter peas. A good soil-improving practice is to add nitrogen to crop residue to hasten its decay. Varying the depth of tillage helps to reduce the formation of a plowpan.

Sprinkler irrigation is the best system. In places commercial fertilizer is needed to help maintain high yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIe-5

The only soil in this unit is Portales fine sandy loam, 0 to 1 percent slopes. It is a deep, well-drained, calcareous, dark to dark grayish-brown, nearly level soil of the upland. It has a permeable, moderately fine textured subsoil.

The soil in this unit is only moderately productive. The lime in the surface layer and subsoil keeps some of the plant nutrients in unavailable form. This soil tills easily and makes a good seedbed. If it is always plowed at the same depth, however, a plowpan forms readily. If continuously cropped, it becomes less fertile and loses its good tilth unless it is well managed. Because the surface layer contains accumulated lime that is highly erodible by wind, this soil is moderately susceptible to wind erosion if left unprotected.

Grain sorghum and cotton are the main cash crops. A cropping system is needed that helps to control wind erosion and to maintain tilth and fertility. A suitable one is grain sorghum, wheat, or a similar residue crop for 1 year and cotton or some other soil-depleting crop for 1 year. Other residue crops that can be used in the cropping system are sweetclover, alfalfa, and winter peas. A good practice is to add nitrogen to crop residue to hasten its decay. Varying the depth of tillage helps to prevent the formation of a plowpan.

Sprinkler irrigation is the best system. In places commercial fertilizer is needed to help maintain high yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIe-6

Miles fine sandy loam, 1 to 3 percent slopes, is the only soil in this unit. It is a deep, well-drained, reddish-brown to brown, gently sloping soil that has a permeable, moderately fine textured subsoil.

This soil is fertile and has moderate capacity to hold moisture and plant nutrients. It tills easily and makes a good seedbed. A plowpan forms readily if the soil is always plowed at the same depth. If continuously cropped, the soil becomes less fertile and loses its tilth. If left unprotected, the soil is moderately susceptible to wind and water erosion.

The main cash crops are cotton and grain sorghum. A cropping system that helps to control erosion and to maintain fertility and tilth is needed. A suitable one is grain sorghum or a similar residue crop for 1 year and cotton or some other soil-depleting crop for 1 year. Sweetclover, vetch, and winter peas are other residue crops that can be used in the cropping system. A good practice is to add nitrogen to crop residue to hasten its decay. Varying the depth of tillage helps to reduce formation of a plowpan.

Sprinkler irrigation is the best system. Terracing is needed for control of water erosion. In some areas commercial fertilizer is needed to help maintain high yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIs-1

This unit consists of deep, brown to very dark grayish-brown, nearly level soils that have a blocky, fine-textured subsoil. The soils in this unit are—

Lofton clay loam.
Pullman silty clay loam, 0 to 1 percent slopes.

These soils are fertile, have high capacity to hold moisture and plant nutrients, and till easily. The compact, blocky subsoil is slowly permeable to water and roots. A

plowpan forms readily if the soils are always plowed at the same depth. If continuously cropped, the soils become less fertile and lose their good tilth, unless well managed. If left unprotected, they are slightly susceptible to wind erosion.

The main cash crops are cotton, wheat, and grain sorghum. A cropping system is needed that helps to control wind erosion and to maintain fertility and tilth. A suitable one consists of wheat (fig. 19), grain sorghum, or a similar residue crop for 1 year and cotton or some other soil-depleting crop for 2 years. Other residue crops that can be used in the rotation are sweetclover, winter peas, and vetch. A good practice is to add nitrogen to crop residue to hasten its decay. Varying the depth of tillage helps prevent formation of a plowpan.

Figure 19.—Stubble-mulching wheat residue on Pullman soils.

Furrow or border irrigation can be used on these soils. Land leveling is needed in some fields to help distribute irrigation water. In some areas commercial fertilizer is needed to help maintain yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIIe-1

This unit includes only Pullman silty clay loam, 1 to 3 percent slopes. It is a deep, brown to dark-brown, gently sloping soil that has a blocky, fine-textured subsoil.

This soil is fertile and has high capacity to hold moisture and plant nutrients. Water and plant roots move slowly through the compact, blocky subsoil. The soil is fairly easy to till and works into a fair seedbed. If continuously cropped, it becomes less fertile and loses its tilth unless it is well managed. A plowpan forms readily if the soil is always plowed at the same depth. If left unprotected, the soil is slightly susceptible to wind erosion and moderately susceptible to water erosion.

Wheat, cotton, and grain sorghum are the main cash crops. A cropping system is needed that helps to control erosion and to maintain fertility and tilth. A suitable one is wheat, grain sorghum, or a similar residue crop for 1 year and cotton or some other soil-depleting crop for 1 year. Sweetclover, winter peas, and vetch are other residue crops that can be used in the cropping system. A good practice is to add nitrogen to the crop residue to hasten its decay. Varying the depth of tillage helps to prevent formation of a plowpan.

Furrow or sprinkler irrigation can be used on this soil. If furrow irrigation is used, bench leveling is needed for control of water erosion, and if sprinkler irrigation is used, terracing is needed. In some areas commercial fertilizer is needed to help maintain high yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIIe-2

The only soil in this unit is Olton loam, 1 to 3 percent slopes. It is a deep, well-drained, reddish-brown to brown, gently sloping soil that has a slowly permeable, moderately fine textured subsoil.

This soil is fertile and has high capacity to hold moisture and plant nutrients. It tills easily and works into a good seedbed. If continuously cropped, this soil becomes less fertile and loses its tilth unless it is well managed. A plowpan forms readily if the soil is always plowed at the same depth. If left unprotected, the soil is susceptible to slight wind erosion and to moderate water erosion.

Wheat, grain sorghum, and cotton are the main cash crops. A cropping system is needed that helps to control erosion and to maintain fertility and tilth. A suitable one is wheat, grain sorghum, or a similar residue crop for 1 year and cotton or some other soil-depleting crop for 1 year. Sweetclover, winter peas, and vetch are other residue crops that can be used in the rotation. A good practice is to add nitrogen to crop residue to hasten its decay. Varying the depth of tillage helps to prevent the formation of a plowpan.

Furrow or sprinkler irrigation can be used. If furrow irrigation is used, bench leveling is needed for the control of water erosion, and if sprinkler irrigation is used, terracing is needed. In some areas commercial fertilizer is needed to help maintain high yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIIe-3

Zita loam, 1 to 3 percent slopes, is the only soil in this unit. It is a deep, well-drained, brown to dark grayish-brown, gently sloping soil that has a permeable, moderately fine textured subsoil.

This soil is fertile and has high capacity to hold moisture and plant nutrients. It tills easily and works into a good seedbed. If continuously cropped, this soil becomes less fertile and loses its tilth. A plowpan forms readily if the soil is always plowed at the same depth. If not protected, the soil is susceptible to slight wind erosion and to moderate water erosion.

The main cash crops are cotton, wheat, and grain sorghum. A cropping system is needed that helps to control erosion and to maintain fertility and tilth. A suitable one is wheat, grain sorghum, or a similar residue crop for 1 year and cotton or some other soil-depleting crop for 1 year. Sweetclover, winter peas, and vetch are other residue crops that can be used in the cropping system. A good practice is to add nitrogen to crop residue to hasten its decay. Varying the depth of tillage helps prevent the formation of a plowpan.

Furrow or sprinkler irrigation can be used. If furrow irrigation is used, bench leveling is needed for control of water erosion, and if sprinkler irrigation is used, terracing is needed. In some areas commercial fertilizer is needed to help maintain high yields. The amount applied should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIIe-4

Portales loam, 1 to 3 percent slopes, is the only soil in this unit. It is a deep, well-drained, dark to dark grayish-brown, gently sloping, calcareous soil that has a permeable, moderately fine textured subsoil.

This soil is only moderately productive. Because the surface layer and subsoil are high in lime, some plant nutrients are in unavailable form. This soil is easily tilled and generally makes a good, friable seedbed. If continuously cropped, it becomes less fertile and loses its tilth unless it is well managed. A plowpan forms readily if the soil is always plowed at the same depth. If left unprotected, this soil is moderately susceptible to wind and water erosion.

Cotton, grain sorghum, and wheat are the main cash crops. A cropping system is needed that helps to control wind and water erosion and to maintain fertility and tilth. A suitable one is wheat, grain sorghum, or a similar residue crop for 2 years and cotton or some other soil-depleting crop for 1 year. Alfalfa, sweetclover, or winter peas are other residue crops that can be used in the rotation. A good practice is to add nitrogen to crop residue to hasten its decay. Varying the depth of tillage helps prevent the formation of a plowpan.

Furrow or sprinkler irrigation can be used. If furrow irrigation is used, bench leveling is needed for the control of water erosion, and if sprinkler irrigation is used, terracing is needed. In some areas commercial fertilizer is needed to help maintain high yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIIe-5

The only soil in this unit is Amarillo fine sandy loam, 1 to 3 percent slopes. It is a deep, well-drained, reddish-brown to brown, gently sloping soil that has a permeable, moderately fine textured subsoil.

This soil is fertile and has moderate capacity to hold moisture and plant nutrients. It tills easily and works into a good seedbed; however, a plowpan forms readily if the soil is always plowed at the same depth. If continuously cropped, this soil becomes less fertile and loses its tilth unless it is well managed. If left unprotected, it is moderately susceptible to wind and water erosion.

The main cash crops are cotton and grain sorghum. A cropping system is needed that helps to control erosion and to maintain fertility and tilth. A suitable one is grain sorghum or a similar residue crop for about 1 year and cotton or some other soil-depleting crop for 1 year. Sweetclover, vetch, and winter peas are other residue crops that can be used in the cropping system. A good practice is to add nitrogen to residue to hasten its decay.

The rest of the acreage can be used for cotton or similar soil-depleting crops. The crops need to be rotated each year for good soil maintenance. Varying the depth of tillage helps prevent formation of a plowpan.

Sprinkler irrigation is the best system. Terracing is needed for control of water erosion. In some areas commercial fertilizer is needed to help maintain high yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIIe-6

The only soil in this unit is Portales fine sandy loam, 1 to 3 percent slopes. It is a deep, well-drained, brown to dark grayish-brown, gently sloping, calcareous soil of the upland. It has a permeable, moderately fine textured subsoil.

This soil is only moderately productive. The lime in the surface layer and subsoil keeps some plant nutrients in an unavailable form. This soil is easily tilled and works into a good, friable seedbed. A plowpan forms, however, if the soil is always plowed at the same depth. If continuously cropped, this soil becomes less fertile and loses its good tilth unless it is well managed. If left unprotected, it is moderately susceptible to wind and water erosion.

Cotton and grain sorghum are the main cash crops. A cropping system is needed that helps to control erosion and to maintain fertility and tilth. A suitable one is grain sorghum or a similar residue crop for about 2 years and cotton or some other soil-depleting crop for 1 year. Other residue crops that can be used in the cropping system are sweetclover, alfalfa, vetch, and winter peas. A good practice is to add nitrogen to crop residue to hasten its decay. Varying the depth of tillage helps to prevent formation of a plowpan.

Sprinkler irrigation is the best system. Terracing is needed to control water erosion. In some areas commercial fertilizer is needed to help maintain high yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIIe-7

In this unit are deep, well-drained, nearly level to gently sloping soils that have a moderately fine textured subsoil. The soils in this unit are—

Amarillo loamy fine sand, 0 to 3 percent slopes.
Miles loamy fine sand, 0 to 3 percent slopes.

These soils absorb water readily but are generally low in organic matter and plant nutrients. The surface layer has low capacity to hold moisture. Generally the soils in this unit till easily, but because of the loose sandy surface layer, they are somewhat difficult to work into a good seedbed. They need good management because they become less fertile if continuously cropped. If left unprotected, they are highly susceptible to blowing.

Cotton and grain sorghum are the main cash crops. A cropping system is needed that helps to control wind erosion and to maintain fertility. A suitable one is grain sorghum, rye, or a similar residue crop for about 1 year and cotton or some other soil-depleting crop for 1 year. Sweetclover, vetch, and alfalfa are other residue crops that can be used in the cropping system. A good practice is to add nitrogen to crop residue to hasten its decay. If not enough residue is produced, wind erosion can be controlled by emergency tillage or deep plowing, or by applying cotton burs.

Sprinkler irrigation is the best system. In some areas commercial fertilizer is needed to help maintain yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIIe-8

This unit consists of moderately shallow, well-drained, dark-colored, nearly level to gently sloping soils. The soils in this unit are—

Mansker fine sandy loam, 0 to 1 percent slopes.
Mansker fine sandy loam, 1 to 3 percent slopes.
Mansker loam, 0 to 1 percent slopes.
Mansker loam, 1 to 3 percent slopes.

These soils have only moderate capacity to hold water and plant nutrients. They generally till easily and make

765-184—66——4

a good seedbed; however, a plowpan forms readily if the soils are always plowed at the same depth. If continuously cropped, these soils become less fertile and lose their good tilth unless they are well managed. If left unprotected, the soils are moderately susceptible to wind and water erosion.

Cotton and grain sorghum are the main crops. A cropping system is needed that helps to control erosion and to maintain fertility and tilth. A suitable one is grain sorghum, wheat, or a similar residue crop for about 3 years and cotton or some other soil-depleting crop for 1 year. Winter peas, vetch, and sweetclover are other residue crops that can be used in the cropping system. A good practice is to add nitrogen to crop residue to hasten its decay.

Border, furrow, or sprinkler irrigation can be used. Land leveling is needed in some fields for proper distribution of irrigation water. If furrow irrigation is used, bench leveling is needed for the control of water erosion on gentle slopes, and if sprinkler irrigation is used, terracing is needed. Cotton burs, crop residue, or soil-improving crops are needed for several years on soils that are bench leveled to improve their tilth and fertility. In places commercial fertilizer is needed to help maintain yields. The amount used should be determined by soil tests.

IRRIGATED CAPABILITY UNIT IIIes-1

The only soil in this unit is Drake clay loam, 1 to 3 percent slopes. It is a moderately deep, well-drained grayish-brown to light brownish-gray, gently sloping soil of the upland. It is high in lime.

This soil is only moderately productive. Because of the lime in the surface layer and subsoil, some of the plant nutrients are kept in unavailable form. In most places this soil tills easily and works into a good seedbed. If continuously cropped, it becomes less fertile and loses its tilth unless it is well managed. A plowpan readily forms, however, if the soil is always plowed at the same depth. If left unprotected, the soil is highly susceptible to wind erosion and is moderately susceptible to water erosion.

The main cash crops are cotton and grain sorghum. A cropping system is needed that helps to control erosion and to maintain fertility and tilth. A suitable one is grain sorghum, wheat, or a similar residue crop for 2 years and cotton or some other soil-depleting crop for 1 year. Other residue crops that can be used in the cropping system are alfalfa, vetch, or sweetclover. A good practice is to add nitrogen to crop residue to hasten its decay.

Border, furrow, or sprinkler irrigation can be used. Land leveling is needed in some fields for distribution of irrigation water. If furrow irrigation is used, bench leveling is needed to control water erosion, and if sprinkler irrigation is used, terracing is needed. In some areas commercial fertilizer is needed to help maintain high yields. The amount used should be determined by soil tests.

Predicted irrigated yields

In table 4 are predicted average yields per acre of the principal crops grown on soils in Crosby County suited to irrigation. The yields shown are those to be expected over a period of years and are for two levels of management.

In columns A are yields expected under a low level of management. The practices do not include use of definite cropping systems, growing of soil-improving crops, applying fertilizers, or efficient use of irrigation water.

In columns B are yields to be expected under a high level of management. A high level of management in this county includes (1) use of land leveling; (2) conserving irrigation water; (3) proper tillage; (4) use of crop residue; (5) use of a cropping system that includes a soil-improving crop; and (6) use of commercial fertilizer. These practices are described in the section "General Management of Irrigated Soils."

TABLE 4.—*Predicted average yields per acre for principal irrigated crops under two levels of management*

[Yields in columns A are obtained at a low level of management; those in columns B are obtained at a high level of management]

Soil	Cotton (lint)		Grain sorghum		Wheat	
	A	B	A	B	A	B
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Bu.*	*Bu.*
Amarillo fine sandy loam, 0 to 1 percent slopes	650	850	4, 000	6, 500	30	45
Amarillo fine sandy loam, 1 to 3 percent slopes	550	750	4, 000	6, 500	25	30
Amarillo loamy fine sand, 0 to 3 percent slopes	525	700	3, 000	5, 000	(1)	(1)
Drake clay loam, 1 to 3 percent slopes	425	550	2, 400	3, 000	(1)	(1)
Lofton clay loam	650	850	4, 500	6, 500	35	50
Lofton fine sandy loam	650	850	4, 000	6, 500	(1)	(1)
Mansker fine sandy loam, 0 to 1 percent slopes	425	550	2, 400	3, 000	25	30
Mansker fine sandy loam, 1 to 3 percent slopes	400	500	2, 350	2, 900	20	25
Mansker loam, 0 to 1 percent slopes	425	550	2, 400	3, 000	25	30
Mansker loam, 1 to 3 percent slopes	400	500	2, 350	2, 900	20	25
Miles fine sandy loam, 0 to 1 percent slopes	650	850	4, 000	6, 500	30	45
Miles fine sandy loam, 1 to 3 percent slopes	550	750	4, 000	6, 500	25	30
Miles loamy fine sand, 0 to 3 percent slopes	525	700	3, 000	5, 000	(1)	(1)
Olton loam, 0 to 1 percent slopes	625	825	4, 500	6, 500	35	50
Olton loam, 1 to 3 percent slopes	550	750	3, 500	5, 500	30	45
Portales fine sandy loam, 0 to 1 percent slopes	550	725	4, 000	5, 500	25	35
Portales fine sandy loam, 1 to 3 percent slopes	500	625	2, 600	4, 000	20	30
Portales loam, 0 to 1 percent slopes	560	780	4, 000	6, 000	30	40
Portales loam, 1 to 3 percent slopes	500	625	2, 700	4, 200	25	30
Pullman silty clay loam, 0 to 1 percent slopes	625	825	4, 500	6, 500	35	50
Pullman silty clay loam, 1 to 3 percent slopes	550	750	3, 000	5, 000	30	45
Spur clay loam	650	850	4, 500	6, 500	35	50
Spur fine sandy loam	600	800	4, 000	6, 000	30	45
Zita fine sandy loam, 0 to 1 percent slopes	650	850	4, 500	6, 000	30	45
Zita loam, 0 to 1 percent slopes	625	825	4, 500	6, 000	35	50
Zita loam, 1 to 3 percent slopes	600	800	4, 000	5, 500	30	45

[1] The crop is not grown on this soil.

Range Management[2]

Approximately 44 percent of the total land area in the county, or about 256,537 acres, is in native grass. The acreage comprises 29 ranching units that range in size from 640 acres to 61,000 acres.

On most ranches the calves produced are marketed at weaning time, but a few ranchers raise finished feeder and stocker steers. On about 90 percent of the ranches, small grain is grazed, or supplemental feed is provided in summer to lessen grazing pressure on the range.

Raising of livestock is secondary to the growing of cotton and grain sorghum in the county. Nevertheless, the potential for increasing production of livestock is good. Irrigated pastures (fig. 20) are being developed in the county. These pastures are productive and are still another source of feed for the cattle industry.

Figure 20.—**Second-year growth of irrigated indiangrass planted for grazing.**

Most of the grassland is in the southern part of the county below the caprock. Grassland above the caprock consists mostly of small tracts of short grasses. The caprock, which consists of very shallow, steep breaks, has a sparse cover of vegetation. Adjacent to the breaks the terrain is rolling and the dominant vegetation is short grasses and mid grasses. On soils along the rivers and major streams are tall grasses. The remaining range has a cover of short and mid prairie grasses.

Range sites and condition classes

Range sites are kinds of rangeland that differ from each other in their ability to produce vegetation. The soils in any one range site produce about the same kind of climax vegetation. *Climax vegetation* is the stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment remains unchanged. Throughout most of the prairie and the plains, the climax vegetation consists of plants that were growing there when the region was first settled. If cultivated crops are not to be grown, the most productive combination of forage plants on a range site is generally the climax type of vegetation.

The range sites in a given climate differ only in the kind or amount of vegetation they can produce. These differences result mainly from differences in soil depth, texture, structure, and position, but also from differences in exposure and elevation.

The kind and amount of vegetation produced on a site depend on the soil and its fertility and aeration and on the amount of water taken in and stored in the profile. The deep, fertile soils in a range site on the bottom land receive floodwater in addition to normal rainfall. Consequently, such a site produces a large amount of taller grasses than an upland site or a shallow site that receives less water.

Grass, like all other green plants, manufactures its food in the green leaves and tender stems. Thus, the continued growth of range plants depends on how they are grazed.

Heavy grazing, or overuse, reduces or destroys leaves and stems of plants and thus reduces the amount of food the plants can manufacture. This process, if continued over a period of years, kills many plants. If grazing is not controlled, the most palatable and nutritious plants are grazed first and are therefore damaged or destroyed first. Plants that decrease under heavy grazing are called *decreasers*.

As the decreasers are thinned out, some of the plants not grazed begin to increase, and eventually these occupy the area once held by the more desirable plants. Plants that increase under heavy grazing are called *increasers*.

As heavy grazing continues, successively less desirable plants are dominant. When the decreasers and increasers are eventually eliminated, plants from nearby sites or from areas father away invade the site. Such plants are known as *invaders*.

Thus, if a range site is overgrazed continuously, the composition of the vegetation changes from the best to the poorest. A range site is in *excellent condition* if more than 75 percent of the present vegetation consists of climax plants. It is in *good condition* if the percentage is from 50 to 75, in *fair condition* if the percentage is 25 to 50, and in *poor condition* if the percentage is less than 25.

Descriptions and interpretations of range sites

Range sites are easy to recognize and have distinguishing characteristics. Therefore, they are the most significant basis for range management. Each site is affected by climate and by the amount of grazing it receives. The way a site is affected depends on the grazing habits of the various kinds of livestock and the palatability of the forage on the site. Therefore, range management requires a knowledge of (1) the range site, (2) the effect of grazing on it, and (3) the proper control of grazing.

Generally, there are several range sites in a pasture, but livestock normally prefer one site. This site can be used as a basis for managing the entire pasture. Correct grazing on this site helps improve the rest of the pasture.

If they are in good to excellent condition, all range sites in the county except the Sandy Land and Deep Sand can be used all year or any season of the year. As a result, the sites are overgrazed and the range deteriorates. The Sandy Land and Deep Sand sites are best suited to grazing in spring and summer because then the tall grasses are more platable and nutritious. Also, the soils in these sites

[2] By Joe B. Norris, range conservationist, Soil Conservation Service, Lubbock, Tex.

are highly susceptible to wind erosion if left unprotected. They therefore need management that insures a plant cover at all times.

All range sites in the county respond to the basic principles of range management: (1) using the proper amount of grazing for maintaining plant cover; (2) grazing the kind of livestock best suited to the range; (3) making necessary adjustments in grazing each season to get the best use of palatable plants without overgrazing any part of the range; and (4) distributing livestock throughout the range so as to obtain uniform grazing.

It may be necessary to supplement these practices with others, such as deferred grazing, brush control, water control, and in the most severe conditions, range seeding.

In some areas soils are so intermingled that they cannot be mapped separately; therefore, they are mapped in a soil complex. In this county the soils in a complex are placed in different range sites. Also, Badland, Randall clay, and Randall fine sandy loam are not classified in range sites. Badland produces nothing for agricultural purposes, and Randall clay and Randall fine sandy loam are included with range sites that are adjacent to the lakebeds where they lie.

The soils of Crosby County have been classified in 13 distinct range sites. They are described briefly in the pages that follow.

LOAMY BOTTOM LAND SITE

The soils in this site are gently sloping and are along draws in the bottom lands. The areas are relatively level to concave and receive extra water from adjacent soils, from infrequent floods, or possibly from a high water table.

The soils in this site and the map symbols are—

Loamy alluvial land (Lm).
Spur clay loam (Sc).
Spur fine sandy loam (Sf).

This site is highly productive and supports such decreasers as sideoats grama and little bluestem, and smaller amounts of switchgrass and sand bluestem. In saline areas the increasers are blue grama, vine-mesquite, western wheatgrass and alkali sacaton and the invaders are inland saltgrass, buffalograss, sand dropseed, mesquite, and annuals.

This site generally makes up only a small part of each operating unit, but it is generally the most productive part of the pasture.

Preliminary data indicate that the potential herbage yield of this site ranges from 3,400 pounds per acre in favorable years to 2,000 pounds in less favorable years.

DEEP HARDLAND SITE

In this site are soils on level to sloping upland plains. In places in the northern and western parts of the county, the plains are interspersed with playa basins.

The soils in this site and the map symbols are—

Abilene clay loam, 0 to 1 percent slopes (AbA).
Abilene clay loam, 1 to 3 percent slopes (AbB).
Berthoud loam, 3 to 5 percent slopes (BmC).
Berthoud loam, 5 to 8 percent slopes (BmD).
Bippus clay loam, 1 to 3 percent slopes (BtB).
Lofton clay loam (Ln).
Olton loam, 0 to 1 percent slopes (OtA).
Olton loam, 1 to 3 percent slopes (OtB).
Pullman silty clay loam, 0 to 1 percent slopes (PuA).
Pullman silty clay loam, 1 to 3 percent slopes (PuB).
Stamford soils, 0 to 1 percent slopes (StA).
Zita loam, 0 to 1 percent slopes (ZmA).
Zita loam, 1 to 3 percent slopes (ZmB).

These soils have high capacity for storing water and plant nutrients, but they absorb water slowly. As only short grasses can exist on a small water supply, blue grama is the dominant decreaser. Sideoats grama, vine-mesquite, western wheatgrass, and similar mid grasses grow in areas that receive extra water from runoff. Buffalograss is the main increaser. The invaders are sand muhly, mesquite, and annual weeds.

In many overgrazed stands of grass, pitting or chiseling can be used to stimulate growth. In places the extra water held by the small playa basins gives the grass an extra chance for survival. This range site can best be improved, though, by keeping a healthy stand of grass on it at all times. Improvement is indicated by the increase in blue grama and the decrease in weeds.

Preliminary data indicate that the potential herbage yield of this site ranges from 2,300 pounds per acre in favorable years to 1,500 pounds in unfavorable years.

MIXED PLAINS SITE

This range site is on nearly level to gently sloping plains that are generally adjacement to draws or natural depressions. The soils are susceptible to severe erosion if the cover of plants on them is sparse. They are highly calcareous, crumbly, and permeable.

The soils of this site and the map symbols are—

Mansker loam, 0 to 1 percent slopes (MkA).
Mansker loam, 1 to 3 percent slopes (MkB).
Mansker loam, 3 to 5 percent slopes (MkC).
Portales fine sandy loam, 0 to 1 percent slopes (PfA).
Portales fine sandy loam, 1 to 3 percent slopes (PfB).
Portales loam, 0 to 1 percent slopes (PmA).
Portales loam, 1 to 3 percent slopes (PmB).

The climax vegetation includes sideoats grama, blue grama, vine-mesquite, Arizona cottontop, needle-and-thread, and other decreasers. The increasers are buffalograss, hairy grama, and black grama.

Among the invaders are three-awn, sand dropseed, sand muhly, catclaw, broom snakeweed, and annuals.

Because the soils contain lime, this site is productive. Under continuous heavy grazing, however, the vegetation degenerates to buffalograss. Nevertheless, this site responds favorably to good management, and particularly if desirable grasses are present to furnish seed.

Preliminary data indicate that the potential herbage yield ranges from 2,200 pounds per acre in favorable years to 1,400 pounds in less favorable years.

SANDY LAND SITE

This range site is made up of coarse-textured soils that are nearly level to moderately sloping. These soils have little or no defined drainage pattern and no long, distinct slope. Unless the soils have a good ground cover, the hazard of wind erosion is high.

The soils of this site and the map symbols are—

Amarillo loamy fine sand, 0 to 3 percent slopes (AmB).
Likes loamy fine sand (Lk).
Miles loamy fine sand, 0 to 3 percent slopes (MmB).
Miles loamy fine sand, 3 to 5 percent slopes (MmC).

A good variety of climax grasses grow on this site. Decreasers in the climax cover includê indiangrass, switch-

grass, sand bluestem, little bluestem, sand lovegrass, sideoats grama, New Mexico feathergrass, and needle-and-thread. The increasers are giant dropseed, sand dropseed, blue grama, hairy grama, silver bluestem, perennial three-awn, hooded windmillgrass, sand paspalum, and fall witchgrass. Included among the more common invaders are gummy lovegrass, tumblegrass, red lovegrass, tumble lovegrass, tumble windmillgrass, fringed signalgrass, yucca, sand sagebrush, skunkbush, skin oak, groundsel, queensdelight, western ragweed, and many annuals.

Shin oak has spread rapidly from the original motts. Sand sagebrush and skunkbush spread fairly rapidly if the adapted grasses are heavily grazed. Applying chemicals by airplane easily controls these species of brush and permits improvement of desirable grasses.

Preliminary data indicate that the potential herbage yield of this site ranges from 3,000 pounds per acre in favorable years to 1,300 pounds in less favorable years.

VERY SHALLOW SITE

This range site consists of nearly level to steep soils that are mostly on ridges, along draws, or above escarpments. These soils are very shallow and have low water-holding capacity. Gravel and pebbles are in the surface layer and throughout the soil profile.

The soils in this site and the map symbols are—

Potter soils (Ps).
Mansker-Potter complex (Potter soil only (Ml).
Vernon-Travessilla complex (Travessilla soil only) (Vb).

The decreasers in the climax vegetation are chiefly sideoats grama, blue grama, and little bluestem. In addition sand bluestem, switchgrass, Canada wildrye, and New Mexico feathergrass also grow in places where variations in topography make moisture more plentiful. Included among the increasers are buffalograss, black grama, hairy grama, sand dropseed, and perennial three-awn. Invaders are hairy tridens, red grama, sand muhly, broom snakeweed, mesquite, and annuals.

This site supports a good variety of grasses. Yields are limited, however, because the soils are very shallow and are therefore low in fertility and water-holding capacity. Consequently, this site cannot be grazed so heavily as the Deep Hardland site.

Broom snakeweed readily invades bare areas. Generally, this noxious shrubby plant must be controlled before desirable grasses can be established.

Preliminary data indicate that the potential herbage yield per acre ranges from 850 pounds in favorable years to 400 pounds in less favorable years.

DEEP SAND SITE

This range site is in rolling to duned areas. The dunes are interspersed throughout the rolling landscape. Drainage patterns are poorly defined or nonexistent. The soils of this site are deep sands that have a high rate of water intake. They are highly susceptible to wind erosion. In areas where vegetation is sparse, active blowouts form readily.

The soils of this site and the map symbols are—

Brownfield fine sand (Br).
Brownfield soils, severely eroded (Bs3).
Tivoli fine sand (Tv).

Indiangrass, sand bluestem, switchgrass, sand lovegrass, big sandreed, New Mexico feathergrass, sideoats grama, and little bluestem are the principal climax decreasers. Important increasers are hairy grama, blue grama, silver bluestem, hooded windmillgrass, and perennial three-awn. Included among the invaders are gummy lovegrass, tumble lovegrass, tumblegrass, red lovegrass, tumble windmillgrass, and fringed signalgrass. Other invaders are yucca, sand sagebrush, skunkbush, groundsel, western ragweed, and many annuals.

Small motts in the climax consist of shin oak. As the grass cover decreases under heavy grazing, low-growing oak spreads rapidly from the motts.

Preliminary data indicate that the potential herbage yield of this site ranges from 3,400 pounds per acre in favorable years to 1,400 pounds in unfavorable years.

HIGH LIME SITE

The soils in this site are on the east side of playa basins. Some of them are in large, sloping dunes, and others are in flats adjacent to the lakes. These immature soils formed from highly calcareous parent material and contain a large amount of free lime. Unless protected by plant cover, these soils are highly susceptible to wind erosion. The slopes are also subject to water erosion.

The soils in this site and the map symbols are—

Drake clay loam, 1 to 3 percent slopes (DcB).
Drake clay loam, 3 to 5 percent slopes (DcC).

Blue grama, vine-mesquite, and sideoats grama make up the climax decreasers. The increasers include buffalograss, black grama, and alkali sacaton. The invaders are inland saltgrass, sand muhly, mesquite, and all annuals.

In some areas there is enough lime in the soils to exclude all vegetation, except alkali sacaton, inland saltgrass, and a few other grasses. In these areas alkali sacaton should be encouraged.

Preliminary data indicate that potential herbage yields of this site range from 1,800 pounds per acre in favorable years to 1,100 pounds in less favorable years.

ROUGH BREAKS SITE

This site consists only of one land type, Rough broken land (Rm). The area has a distinct drainage pattern marked by steep slopes and bluffs. Geologic erosion is severe. The soil material is medium to moderately fine textured.

The decreasers in the climax vegetation include sideoats grama, blue grama, and little bluestem. The increasers are hairy grama, black grama, buffalograss, and silver bluestem. Dominant among the numerous invaders are Texas grama, hairy tridens, mesquite, red-berry juniper, pricklypear, and catclaw.

Good management is needed on this site to maintain a grass cover for control of runoff and thus control water erosion, which is generally severe.

Preliminary data indicate that the potential herbage yield ranges from 900 pounds per acre in favorable years to 500 pounds in less favorable years.

SANDY LOAM SITE

The soils in this site are gently sloping to moderately steep and are in the upland plains. Slopes are mostly less than 8 percent. In places the areas are on ridges or are on rolling terrain.

The soils of this site and the map symbols are—

Amarillo fine sandy loam, 0 to 1 percent slopes (AfA).
Amarillo fine sandy loam, 1 to 3 percent slopes (AfB).
Berthoud fine sandy loam, 1 to 3 percent slopes (BfB).
Berthoud fine sandy loam, 3 to 5 percent slopes (BfC).
Berthoud fine sandy loam, 5 to 8 percent slopes (BfD).
Lofton fine sandy loam (Lp).
Mansker fine sandy loam, 0 to 1 percent slopes (MaA).
Mansker fine sandy loam, 1 to 3 percent slopes (MaB).
Mansker fine sandy loam, 3 to 5 percent slopes (MaC).
Mansker-Potter complex (Mansker soil only) (Ml).
Miles fine sandy loam, 0 to 1 percent slopes (MnA).
Miles fine sandy loam, 1 to 3 percent slopes (MnB).
Miles fine sandy loam, 3 to 5 percent slopes (MnC).
Zita fine sandy loam, 0 to 1 percent slopes (ZfA).

On this site the decreasers in the climax vegetation are sideoats grama, little bluestem, Arizona cottontop, plains bristlegrass, and vine-mesquite. The increasers are buffalograss, blue grama, hairy grama, and silver bluestem. Fall witchgrass, mesquite, pricklypear, yucca, and all annuals are invaders.

This site is highly productive and produces a wide variety of plants. The soils absorb moisture readily, even from light rain, and contain enough clay to hold moisture for long periods. This site is therefore desirable for ranching.

Preliminary data indicate that the potential herbage yield per acre on this site ranges from 2,550 pounds in favorable years to 1,800 pounds in less favorable years.

GRAVELLY SITE

Only one land type, Hilly gravelly land (Hg), is in this site. It consists of gently rolling to steep hills, the slopes of which are covered with gravel.

This site produces a wide variety of plants. Decreasers in the climax vegetation are dominantly sideoats grama, blue grama, little bluestem, black grama, and Arizona cottontop, but smaller amounts of sand bluestem, indiangrass, and switchgrass also grow in more favorable spots. Increasers include hairy grama, buffalograss, silver bluestem, Texas wintergrass, and a small amount of shin oak. Invaders are Texas grama, sand muhly, hairy tridens, fall witchgrass, mesquite, catclaw, pricklypear, and many annuals.

Preliminary data indicate that the potential herbage yield on this site ranges from 1,800 pounds per acre in favorable years to 1,100 pounds in less favorable years.

SHALLOW REDLAND SITE

This range site on the upland plains generally consists of rolling hills, ridges, or gently sloping terrain.

The soils of this site and the map symbols are—

Vernon clay loam, 1 to 3 percent slopes (VcB).
Vernon clay loam, 3 to 15 percent slopes (VcD).
Vernon-Travessilla complex (Vernon soil only).

In most areas short grasses are characteristic of this site, but some mid grasses grow in areas that have a more favorable supply of moisture. Blue grama, sideoats grama, and vine-mesquite are the decreasers. Buffalograss, tobosagrass, hairy grama, and silver bluestem are the increasers. The invaders are hairy tridens, sand muhly, Texas grama, red grama, mesquite, pricklypear, red-berry juniper, and annuals.

Preliminary data indicate that the potential herbage yield per acre on this site ranges from 1,600 pounds in favorable years to 900 pounds in less favorable years.

CLAY FLAT SITE

The only soil in this range site is Stamford clay, 1 to 3 percent slopes (SmB). The site is on upland flats and in some areas is surrounded by or is adjacent to higher lying hills.

Decreasers in the climax vegetation include sideoats grama, blue grama, western wheatgrass, white tridens, and vine-mesquite. Increasers are tobosagrass, buffalograss, and in saline areas, alkali sacaton. Invaders are mesquite, cholla cactus, lotebush, and annuals.

Continued heavy grazing has reduced the density of the various plants in the climax vegetation. Tobosagrass, an aggressive increaser, has spread rapidly, and in most areas, now dominates this site. Intensive management is needed to utilize the tobosagrass and to encourage growth of the better decreasers.

Preliminary data indicate that the potential herbage yield of this site ranges from 2,000 pounds per acre in favorable years to 800 pounds in less favorable years.

SANDY BOTTOM LAND SITE

This range site consists only of Sandy alluvial land (Sa). It is nearly level and is adjacent to the larger rivers and small streams in the county.

This site produces a wide variety of vegetation. Decreasers include sand bluestem, indiangrass, switchgrass, little bluestem, sideoats grama, and Canada wildrye. Increasers are mainly meadow dropseed, vine-mesquite, silver bluestem, Texas bluegrass, western wheatgrass, and hairy grama, but in saline areas alkali sacaton is an increaser. Invaders are sand dropseed, buffalograss, three-awn, hooded windmill grass, western ragweed, sand sagebrush, mesquite, inland saltgrass, and saltcedar.

Deposits from floods are laid down in many areas. In some areas the deposits are so thick that the grass is smothered and the ground is almost bare.

Preliminary data indicate that the potential herbage yield of this site per acre ranges from 3,500 pounds in favorable years to 2,200 pounds in less favorable years.

Engineering Uses of the Soils[3]

This soil survey report contains information about the soils of Crosby County that can be used by engineers to—

1. Make soil and land use studies that will aid in the selection and development of industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in the planning of terraces, farm ponds, irrigation systems, and other structures for the conservation of soil and water.
3. Make preliminary evaluations of soil and ground conditions that will aid in the selection of locations for highways, airports, and pipelines and in planning detailed investigations of soils at the selected sites.
4. Locate probable sources of topsoil and of gravel, sand, and other construction materials.
5. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structures.

[3] By Y. E. McAdams, area engineer, Soil Conservation Service, Lubbock, Tex.

6. Determine the suitability of soils for the cross-county movement of vehicles and construction equipment.
7. Obtain supplemental information from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

Some terms used by the soil scientists may have different meanings than those used in engineering. Many of these terms are defined in the Glossary. Some of the terms used in engineering are defined in this section.

The engineering interpretations reported here can be useful for many purposes. It should be emphasized, however, that they may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. Nevertheless, even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Engineering classification systems

Most highway engineers classify soil materials according to the system approved by the American Association of State Highway Officials (AASHO) (*1*). In this system soil materials are classified in seven principal groups. The groups range from A–1, in which are gravelly soils of high bearing capacity, to A–7, which consists of clay soils having low strength when wet. In each group the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. The group index number is shown in parentheses following the soil group symbol in the next to last column in table 7.

Some engineers prefer to use the Unified soil classification system (*16*). In this system soil material is divided into 15 classes: 8 classes are for coarse-grained material (GW, GP, GM, GC, SW, SP, SM, SC); 6 are for fine-grained material (ML, CL, OL, MH, CH, OH); and 1 is for highly organic material (Pt). Mechanical analyses are used to determine the GW, GP, SW, and SP classes of material; mechanical analyses and tests for liquid limit and plasticity index are used to identify GM, GC, SM, SC, and fine-grained soils. The soils of this county are classified only in the CL, CH, SC, SP, SM, and ML classes.

Soil properties significant to engineering

The engineer should know the physical properties of the soil materials and their in-place conditions, as this enables him to make the best use of the soil maps and the soil survey report.

Two tables are given in this section. In the first (table 5) the soils are briefly described, and the estimated physical properties significant to engineering are given. In the second (table 6) some engineering interpretations are given.

The mapping units Badland, Hilly gravelly land, Loamy alluvial land, Rough broken land, and Sandy alluvial land were not included in tables 5 and 6. These mapping units lack definite uniform characteristics and require detailed on-site investigation before being used for engineering works.

The Unified and AASHO classifications for the Pullman, Olton, Miles, and Zita soils in table 5 are based on test data given in table 7. The classifications for the rest of the soils in table 5 are based on data from field tests or from the soil survey reports on Lynn, Dawson, Lamb, and Terry Counties (*12*, *13*, *14*, *15*).

Additional information for the engineering section was obtained from personnel of the Bureau of Public Roads, the Texas State Highway Department, and local representatives of the Soil Conservation Service.

Permeability, as shown in table 5, was estimated for the soil material as it occurs without compaction. The available water-holding capacity gives the estimated number of inches of water held in each inch of soil depth when the soil is wet to field capacity. When the soil is air dry, this is the amount of water needed to wet the soil material to a depth of 1 inch without percolating deeper. An air-dry soil has a moisture content at which most common crop plants wilt.

The shrink-swell potential indicates the volume change of the soil to be expected with changes in moisture content.

The soils are evaluated for engineering use in table 6. Specific features in the soil profile that may affect engineering work are pointed out. These features are estimated from data in table 5, from actual test data available, and from field experience in the performance of the soils.

The ratings of the soils for road subgrade in table 6 are based on the estimated classification of the soil material. On flat terrain the ratings apply to the soil material in the A and B horizons. On steeper terrain (6 percent slopes, or steeper), they apply mainly to the soil materials in the C horizon. Soils that have a plastic clay layer, such as Abilene clay loam, Randall clay, and Lofton clay loam, have impeded internal drainage and low stability when wet. Such soils are rated "Poor." The loamy fine sands are very erodible and have a large percentage passing the No. 200 sieve. These soils are rated "Poor to Fair." This rating is based on their poor grading and general lack of stability unless they are properly confined. The coarser textured and better graded soils are rated as "Fair."

The suitability of the soil for road fill depends largely on its natural water content and texture. The plastic soils, similar to Randall clay and Lofton clay loam, have a high content of natural water and are difficult to handle, to compact, and to dry to the desired content of water. They are therefore rated "Poor." The very sandy soils do not contain enough binding material and are therefore difficult to place and to compact. These soils are rated "Poor to fair."

Embankments used for impounding water can be safely constructed from nearly all the soils, but they must be carefully placed and compacted. In places the reservoir area for ponds needs special practices to reduce excessive seepage.

The soils in this county are suited to the sprinkler and surface methods of irrigation. Sprinkler irrigation may be used on all the soils and is best suited to coarse-textured, sandy or more rolling soils. If the depth of the soil is 20 inches or more, surface irrigation may be preferable to the sprinkler method on fine- and medium-textured soils that have nearly level, uniform slopes

TABLE 5.—*Brief descriptions and the*

Map symbol	Soil	Description	Depth from surface
			Inches
AbA AbB	Abilene clay loam, 0 to 1 percent slopes. Abilene clay loam, 1 to 3 percent slopes.	5 to 7 inches of clay loam over 38 to 48 inches of slowly permeable heavy clay loam; formed on unconsolidated loamy outwash.	0–6 6–52 52 62+
AfA AfB	Amarillo fine sandy loam, 0 to 1 percent slopes. Amarillo fine sandy loam, 1 to 3 percent slopes.	6 to 12 inches of fine sandy loam over 22 to 65 inches of moderately permeable sandy clay loam; formed on unconsolidated, moderately sandy outwash and eolian sediments.	0–10 10–38 38–66+
AmB	Amarillo loamy fine sand, 0 to 3 percent slopes.	12 to 18 inches of loamy fine sand over 30 to 50 inches of moderately permeable sandy clay loam; formed on sandy outwash and eolian sediments.	0–16 16–58 58–62+
BfB	Berthoud fine sandy loam, 1 to 3 percent slopes.	12 to 20 inches of fine sandy loam over 12 to 30 inches of moderately permeable loam; formed on loamy outwash.	0–18 18–30 30–60+
BfC BfD	Berthoud fine sandy loam, 3 to 5 percent slopes. Berthoud fine sandy loam, 5 to 8 percent slopes.	6 to 12 inches of fine sandy loam over 18 to 40 inches of rapidly permeable fine sandy loam; formed on colluvium and alluvium.	0–10 10–40 40–60+
BmC BmD	Berthoud loam, 3 to 5 percent slopes. Berthoud loam, 5 to 8 percent slopes.	6 to 11 inches of loam over 12 to 35 inches of rapidly permeable loam; formed on colluvium and alluvium.	0–9 9–38 38–50+
BtB	Bippus clay loam, 1 to 3 percent slopes.	11 to 16 inches of clay loam over 10 to 28 inches of moderately permeable clay loam; formed on loamy outwash.	0–14 14–41 41–60+
Br Bs3	Brownfield fine sand. Brownfield soils, severely eroded.	15 to 42 inches of fine sand over 25 to 35 inches of moderately permeable sandy clay loam; formed from sandy eolian materials.	0–22 22–52 52–70+
DcB DcC	Drake clay loam, 1 to 3 percent slopes. Drake clay loam, 3 to 5 percent slopes.	5 to 11 inches of clay loam over 11 to 25 inches of moderately permeable clay loam; formed from highly calcareous eolian materials.	0–8 8–30 30–56+
Lk	Likes loamy fine sand.	8 to 20 inches of loamy fine sand over 12 to 28 inches of rapidly permeable loamy fine sand; formed on alluvium.	0–10 10–30 30–50+
Ln	Lofton clay loam.	6 to 8 inches of clay loam over 20 to 50 inches of very slowly permeable clay; formed from silty and sandy clay.	0–6 6–34 34–50+
Lp	Lofton fine sandy loam.	5 to 15 inches of fine sandy loam over 12 to 42 inches of slowly permeable clay loam; formed from clay loam and clay.	0–12 12–42 42–72+
MaA MaB MaC	Mansker fine sandy loam, 0 to 1 percent slopes. Mansker fine sandy loam, 1 to 3 percent slopes. Mansker fine sandy loam, 3 to 5 percent slopes.	4 to 9 inches of fine sandy loam over 6 to 14 inches of moderately permeable clay loam; formed from calcareous loam and clay loam.	0–7 7–14 14–35
MkA MkB MkC	Mansker loam, 0 to 1 percent slopes. Mansker loam, 1 to 3 percent slopes. Mansker loam, 3 to 5 percent slopes.	Similar to Mansker fine sandy loam, but the surface layer is more loamy.	0–7 7–14 14–35
Ml	Mansker-Potter complex.	Refer to Mansker fine sandy loams for properties of the Mansker soil in this complex and to Potter soils for properties of the Potter soil in the complex.	

estimated physical properties of the soils

Classification			Percentage passing sieve—			Permeability	Available water-holding capacity	Reaction	Shrink-swell potential
USDA texture	Unified	AASHO	No. 4	No. 10	No. 200				
						Inches per hour	*Inches per inch of depth*	*pH*	
Clay loam	CL	A-6	100	100	60-70	0. 25-0. 8	0. 20	7. 0-7. 8	Moderate.
Clay loam	CL	A-7	100	100	75-85		. 20	7. 5-8. 0	High.
Clay loam	CL	A-6	100	100	70-80		. 12	8. 0-8. 5	Moderate.
Fine sandy loam	SM-SC	A-4	100	100	40-50	0. 75-2. 0	. 13	7. 0-7. 8	Low.
Sandy clay loam	SC or CL	A-6	100	100	45-60		. 15	7. 5-8. 0	Moderate.
Sandy clay loam	SC or CL	A-6	100	100	45-60		. 13	8. 0-8. 5	Moderate.
Loamy fine sand	SM	A-2	100	100	15-20	1. 0-3. 0	. 08	7. 0-7. 8	Low.
Sandy clay loam	SC or CL	A-6	100	100	40-55		. 12	7. 0-7. 8	Moderate.
Clay loam	CL	A-6	100	100	50-60		. 12	7. 0-7. 8	Moderate.
Fine sandy loam	SM	A-2	95-100	90-100	15-25	1. 0-2. 0	. 13	7. 8-8. 5	Low.
Loam	SC or CL	A-4 or A-6	95-100	90-100	40-55		. 15	8. 0-8. 5	Moderate.
Loam	SC or CL	A-4 or A-6	95-100	90-100	40-55		. 15	8. 0-8. 5	Moderate.
Fine sandy loam	SM-SC	A-4	95-100	95-100	40-50	1. 5-2. 5	. 13	8. 0-8. 5	Low.
Fine sandy loam	SC	A-4 or A-6	95-100	95-100	40-50		. 13	8. 0-8. 5	Moderate.
Fine sandy loam	SC	A-4 or A-6	95-100	95-100	40-50		. 13	8. 0-8. 5	Moderate.
Loam	SC or CL	A-6	95-100	95-100	40-55	1. 0-2. 0	. 17	8. 0-8. 5	Moderate.
Loam	SC or CL	A-6	95-100	95-100	40-55		. 17	8. 0-8. 5	Moderate.
Loam	SC or CL	A-6	95-100	95-100	40-55		. 10	8. 0-8. 5	Moderate.
Clay loam	CL	A-6	95-100	95-100	60-70	0. 5-1. 5	. 15	7. 8-8. 5	Moderate.
Clay loam	CL	A-6	95-100	90-100	55-65		. 15	8. 0-8. 5	Moderate.
Clay loam	CL	A-6	95-100	85-100	55-65		. 20	8. 0-8. 5	Moderate.
Fine sand	SP-SM	A-2 or A-3	100	100	5-15	2. 0-3. 0	. 07	6. 5-7. 2	Low.
Sandy clay loam	SC	A-6	100	100	30-45		. 13	6. 5-7. 0	Moderate.
Loamy fine sand	SM	A-2	100	100	15-25		. 13	6. 5-7. 0	Moderate.
Clay loam	CL	A-6	100	100	50-65	0. 75-2. 0	. 15	8. 0-8. 5	Moderate.
Clay loam	CL	A-6	100	100	55-65		. 15	8. 0-8. 5	Moderate.
Clay loam	CL	A-6	100	100	55-65		. 13	8. 0-8. 5	Moderate.
Loamy fine sand	SM	A-2	100	100	10-25	2. 5-5. 0	. 08	8. 0-8. 5	Low.
Loamy fine sand	SM	A-2	100	100	10-25		. 08	8. 0-8. 5	Low.
Fine sand	SP-SM	A-2 or A-3	100	100	5-15		. 08	8. 0-8. 5	Low.
Clay loam	CL	A-6 or A-7	100	100	60-70	0. 05-0. 2	. 18	7. 2-7. 8	Moderate.
Clay	CL or CH	A-7	100	100	65-80		. 18	7. 2-7. 8	High.
Silty clay loam	CL	A-6	100	100	60-70		. 15	8. 0-8. 5	Moderate.
Fine sandy loam	SM-SC	A-4	100	100	35-50	0. 6-1. 2	. 13	7. 2-7. 8	Low.
Clay loam	CL	A-6 or A-7	100	100	70-80		. 15	7. 2-7. 8	Moderate.
Clay loam	CL	A-6	95-100	95-100	55-65		. 17	8. 0-8. 5	Moderate.
Fine sandy loam	SM-SC	A-4	95-100	95-100	40-50	1. 0-2. 0	. 12	8. 0-8. 5	Low.
Clay loam	CL	A-6	95-100	95-100	50-60		. 15	8. 0-8. 5	Moderate.
Clay loam	CL	A-6	95-100	95-100	50-60		. 07	8. 0-8. 5	Moderate.
Loam	CL	A-4	95-100	95-100	50-60	0. 75-1. 5	. 17	8. 0-8. 5	Moderate.
Clay loam	CL	A-6	100	100	55-65		. 17	8. 0-8. 5	Moderate.
Clay loam	CL	A-6	100	95-100	60-70		. 09	8. 0-8. 5	Moderate.

765-184—65——5

TABLE 5.—*Brief descriptions and the*

Map symbol	Soil	Description	Depth from surface
			Inches
MnA MnB MnC	Miles fine sandy loam, 0 to 1 percent slopes. Miles fine sandy loam, 1 to 3 percent slopes. Miles fine sandy loam, 3 to 5 percent slopes.	5 to 9 inches of fine sandy loam over 20 to 58 inches of moderately permeable sandy clay loam; formed on moderately sandy outwash.	0–6 6–46 46–64+
MmB MmC	Miles loamy fine sand, 0 to 3 percent slopes. Miles loamy fine sand, 3 to 5 percent slopes.	10 to 18 inches of loamy fine sand over 20 to 58 inches of moderately permeable sandy clay loam; formed on moderately sandy outwash.	0–16 16–46 46–64+
OtA OtB	Olton loam, 0 to 1 percent slopes. Olton loam, 1 to 3 percent slopes.	6 to 9 inches of loam over 24 to 42 inches of slowly permeable clay loam; formed from calcareous clay loam.	0–8 8–42 42–65+
PfA PfB	Portales fine sandy loam, 0 to 1 percent slopes. Portales fine sandy loam, 1 to 3 percent slopes.	7 to 22 inches of fine sandy loam over 10 to 25 inches of moderately permeable clay loam; formed from highly calcareous clay loam.	0–14 14–30 30–60+
PmA PmB	Portales loam, 0 to 1 percent slopes. Portales loam, 1 to 3 percent slopes.	Similar to Portales fine sandy loam, but the surface layer is more loamy.	0–14 14–30 30–60+
Ps	Potter soils.	2 to 12 inches of clay loam over partly cemented caliche.	0–8 8–12+
PuA PuB	Pullman silty clay loam, 0 to 1 percent slopes. Pullman silty clay loam, 1 to 3 percent slopes.	5 to 9 inches of silty clay loam over 22 to 35 inches of very slowly permeable clay; formed in silty and clayey sediments.	0–7 7–41 41–60+
Ra	Randall clay.	Consists of dense clay to a depth of 6 feet; may be calcareous or noncalcareous; occupies areas in intermittent lakebeds that range in size from 5 to 60 acres; from 3 to 50 feet below the level of the surrounding plain; receives runoff from adjacent areas and is submerged for long periods; formed in calcareous clay material.	0–25 25–52 52–60+
Rf	Randall fine sandy loam.	10 to 20 inches of fine sandy loam over 4 to 5 feet of poorly drained clay; on the floors of enclosed depressions or intermittent lakes.	0–20 20–52 52–60+
Sc	Spur clay loam.	4 to 5 feet of well-drained, calcareous alluvial loam or clay loam; on flood plains of ancient draws.	0–12 12–34 34–62+
Sf	Spur fine sandy loam.	Same as Spur clay loam, but the surface layer is fine sandy loam.	0–14 14–37 37–60+
SmB	Stamford clay, 1 to 3 percent slopes.	5 to 40 inches of clay over calcareous clay from red beds.	0–7 7–38 38–48+
StA	Stamford soils, 0 to 1 percent slopes.	10 to 14 inches of clay loam over 22 to 40 inches of slowly permeable clay; formed on clayey alluvium.	0–10 10–32 32–48
Tv	Tivoli fine sand.	6 to 7 feet of well-drained fine sand that was deposited by wind during the Quaternary period.	0–10 10–60+
Vb	Vernon-Travessilla complex.	The estimated properties given in the columns to the right are for the Travessilla soil (mapped only in complex with the Vernon soil). The Travessilla soil consists of 2 to 5 inches of fine sandy loam over indurated sandstone. Refer to Vernon clay loams for estimated properties of the Vernon soil in this complex.	0–3

estimated physical properties of the soils—Continued

Classification			Percentage passing sieve—			Permeability	Available water-holding capacity	Reaction	Shrink-swell potential
USDA texture	Unified	AASHO	No. 4	No. 10	No. 200				
						Inches per hour	*Inches per inch of depth*	*pH*	
Fine sandy loam	SM-SC or SC.	A-2	100	100	20-35	0. 75-2. 0	0. 13	7. 0-7. 8	Low.
Sandy clay loam	SC or CL	A-6	100	100	45-60		. 13	7. 0-7. 8	Moderate.
Sandy clay loam	SC or CL	A-6	90-100	90-100	35-55		. 14	8. 0-8. 5	Moderate.
Loamy fine sand	SM	A-2	100	95-100	10-25	1. 0-3. 0	. 10	7. 0-7. 8	Low.
Sandy clay loam	SC	A-2 or A-6	100	100	25-40		. 13	7. 0-7. 8	Moderate.
Sandy clay loam	SC	A-2 or A-6	100	100	25-40		. 13	7. 0-7. 8	Moderate.
Loam	CL	A-6	100	100	60-75	0. 25-0. 80	. 18	7. 0 7. 8	Moderate.
Clay loam	CL	A-6 or A-7	95-100	90-100	70-80		. 20	7. 0-7. 8	Moderate.
Clay loam	CL	A-6	90-100	90-100	60-75		. 13	8. 0-8. 5	Moderate.
Fine sandy loam	SM-SC	A-4	100	100	40-50	0. 75-2. 00	. 12	8. 0-8. 5	Low.
Clay loam	CL	A-6	100	100	50-60		. 14	8. 0-8. 5	Moderate.
Clay loam	CL	A-6	85-95	80-90	50-60		. 10	8. 0-8. 5	Moderate.
Loam	CL	A-6	95-100	95-100	50-65	0. 50-1. 50	. 15	8. 0-8. 5	Moderate.
Clay loam	CL	A-6	95 100	95 -100	55 65		. 15	8. 0-8. 5	Moderate.
Clay loam	CL	A-6	95-100	95-100	55-65		. 10	8. 0-8. 5	Moderate.
Clay loam	ML or CL	A-4 or A-6	90-100	85-95	50-60	0. 75-1. 50	. 15	8. 0-8. 5	Moderate.
Caliche	CL	A-6	85-95	85-95	50-60			8. 0 8. 5	Moderate.
Silty clay loam	CL	A-6	100	100	70-85	0. 05-0. 20	. 18	7. 0-7. 8	Moderate.
Clay	CL	A-6 or A-7	95-100	90-100	75-85		. 18	7. 0-7. 8	Moderate.
Clay loam	CL	A 6 or A-7	95-100	90-100	70-80		. 13	8. 0-8. 5	Moderate.
Clay	CL	A-7	100	100	80-90	0. 05-0. 10	. 18	8. 0 8. 5	High.
Clay	CL or CH	A-7	100	100	80-90		. 18	8. 0-8. 5	High.
Clay	CL	A-7	100	100	80-90		. 18	8. 0-8. 5	High.
Fine sandy loam	SM-SC	A-4	100	100	40-50	0. 10-0. 20	. 13	8. 0-8. 5	Moderate.
Clay	CL	A-6 or A-7	100	100	55-65		. 18	8. 0-8. 5	Moderate.
Clay	CL	A-7	100	100	60-70		. 18	8. 0-8. 5	High.
Clay loam	CL	A-6	100	100	55-65	0. 50-1. 50	. 17	7. 8-8. 3	Moderate.
Loam	CL	A-4 or A-6	100	100	55-65		. 17	7. 8-8. 3	Moderate.
Clay loam	CL	A-6	100	100	55-65		. 15	7. 8-8. 3	Moderate.
Fine sandy loam	SM-SC	A-4	100	100	40-50	1. 0-2. 5	. 13	7. 8-8. 3	Low.
Clay loam	CL	A-6	100	100	50-60		. 14	7. 8-8. 3	Moderate.
Loam	CL	A-4 or A-6	100	95-100	50-60		. 13	7. 8-8. 3	Moderate.
Clay	CL	A-7	100	100	80-90	0. 05-0. 20	. 18	7. 8-8. 3	High.
Clay	CL	A-7	100	100	80-90		. 18	7. 8-8. 3	High.
Clay	CL	A-7	100	100	80-90		. 18	7. 8-8. 3	High.
Clay loam	CL	A-6	100	100	55-65	0. 10-0. 30	. 18	7. 5-8. 0	Moderate.
Clay	CL	A-6 or A-7	100	100	55-70		. 20	7. 8-8. 3	Moderate.
Clay	CL	A-6	100	100	55-65		. 20	7. 8-8. 3	Moderate.
Fine sand	SP-SM	A-3	100	95-100	0 10	5. 00-8. 00	. 07	7. 8-8. 3	Low.
Fine sand	SP-SM	A-3	100	95-100	0-10		. 07	7. 8-8. 3	Low.
Fine sandy loam	SM-SC or CL.	A-4 or A-6	85-90	85-95	40 65	0. 75-1. 50	. 13	7. 8-8. 0	Moderate.

TABLE 5.—*Brief descriptions and the*

Map symbol	Soil	Description	Depth from surface
			Inches
VcB VcD	Vernon clay loam, 1 to 3 percent slopes. Vernon clay loam, 3 to 15 percent slopes.	6 to 14 inches of clay loam or clay over calcareous clays from red beds.	0–6 6–14 14–20+
ZfA	Zita fine sandy loam, 0 to 1 percent slopes.	8 to 22 inches of fine sandy loam over 6 to 30 inches of well-drained clay loam; formed over highly calcareous eolian material.	0–18 18–32 32–60+
ZmA ZmB	Zita loam, 0 to 1 percent slopes. Zita loam, 1 to 3 percent slopes.	8 to 22 inches of loam over 6 to 30 inches of well-drained clay loam; formed over highly calcareous eolian material.	0–18 18–32 32–60+

TABLE 6.—*Engineering*

Soil type	Suitability for—		Suitability as source of topsoil	Soil features affecting—
	Road subgrade	Road fill		Dikes or levees
Abilene clay loam (AbA, AbB)	Poor	Fair	Fair	Slow permeability; fair stability
Amarillo fine sandy loam (AfA, AfB)	Fair	Fair	Fair	Moderate permeability; fair stability.
Amarillo loamy fine sand (AmB)	Poor to fair	Fair	Poor to fair	Moderate permeability; fair stability in subsoil.
Berthoud fine sandy loam (BfB, BfC, BfD)	Poor to fair	Fair	Fair	Moderately rapid permeability; fair stability.
Berthoud loam (BmC, BmD)	Poor	Poor to fair	Fair	Moderate permeability; fair stability.
Bippus clay loam (BtB)	Poor	Fair	Fair	Moderate permeability; fair stability.
Brownfield fine sand (Br)	Fair	Fair	Poor	Fair stability in subsoil
Brownfield soils (Bs3)	Fair	Fair	Poor	Moderately rapid permeability; fair stability.
Drake clay loam (DcB, DcC)	Poor	Fair	Poor to fair	Moderate permeability; fair stability.
Likes loamy fine sand (Lk)	Fair	Fair	Poor	Moderately rapid permeability; poor stability.
Lofton clay loam (Ln)	Poor	Poor	Fair to good	Slow permeability; fair stability
Lofton fine sandy loam (Lp)	Poor to fair	Fair	Fair to good	Slow permeability; fair stability
Mansker fine sandy loam (MaA, MaB, MaC).	Poor to fair	Fair	Fair	Moderately rapid permeability
Mansker loam (MkA, MkB, MkC) Mansker-Potter complex (Ml).[1]	Poor to fair	Fair	Fair	Moderately rapid permeability; fair stability.
Miles fine sandy loam (MnA, MnB, MnC)	Fair to good	Good	Fair to good	Moderately rapid permeability; fair stability.
Miles loamy fine sand (MmB, MmC)	Fair to good	Good	Poor	High permeability; fair stability if confined.
Olton loam (OtA, OtB)	Poor	Fair	Fair to good	Slow permeability; fair stability

See footnote on following page.

estimated physical properties of the soils—Continued

Classification			Percentage passing sieve—			Permea-bility	Available water-holding capacity	Reaction	Shrink-swell potential
USDA texture	Unified	AASHO	No. 4	No. 10	No. 200				
						Inches per hour	*Inches per inch of depth*	*pH*	
Clay loam	CL	A-6	100	95–100	55–65	0.10–0.20	0.17	7.3–7.8	Moderate.
Clay	CL	A-6	100	95–100	60–70		.18	7.3–7.8	Moderate.
Clay	CL	A-6	100	95–100	60–70		.17	7.3–7.8	Moderate.
Fine sandy loam	SC	A-4 or A-6	100	100	40–50	0.75–2.00	.13	7.0–7.5	Low.
Clay loam	CL	A-6	95–100	95–100	50–60		.18	7.8–8.3	Moderate.
Clay loam	CL	A-6	95–100	85–100	50–60		.12	7.8–8.3	Moderate.
Loam	CL	A-4 or A-6	100	100	50–60	0.50–1.50	.16	7.0–7.5	Moderate.
Clay loam	CL	A-6	95–100	95–100	65–70		.18	7.8–8.3	Moderate.
Clay loam	CL	A-6	90–100	85–100	55–65		.13	7.8–8.3	Moderate.

interpretations of the soils

Soil features affecting—				
Farm ponds		Irrigation	Field terraces and diversion terraces	Waterways
Reservoir area	Embankment			
Slow permeability; calcareous substratum.	Fair stability	High water-holding capacity; low intake rate.	Slightly erodible; slow permeability.	Slightly erodible; supports vegetation.
Moderate to high seepage.	Moderate permeability; fair stability.	Moderately high water-holding capacity.	Subject to gully and sheet erosion; moderate permeability.	Erodible.
Moderate to excessive seepage.	Fair stability in subsoil.	Moderately high water-holding capacity.	High susceptibility to wind erosion.	Highly erodible.
Moderate loss from seepage.	Fair stability	Moderately high water-holding capacity.	Subject to gully and sheet erosion.	Erodible.
Moderate loss from seepage.	Fair stability	Moderately high water-holding capacity.	Subject to gully and sheet erosion.	Erodible.
Moderate loss from seepage.	Fair stability	High water-holding capacity.	Subject to gully and sheet erosion.	Erodible.
Excessive seepage	Fair stability in subsoil.	Moderate water-holding capacity.	High susceptibility to wind erosion.	Highly erodible.
Excessive seepage	Fair stability with flat slopes.	High intake rate; moderate water-holding capacity.	High wind erosion	Highly erodible.
Moderate seepage	Fair stability	Moderate intake rate; moderate water-holding capacity.	High susceptibility to wind erosion.	Erodible.
High seepage	Poor stability	Low water-holding capacity.	High susceptibility to wind erosion.	Highly erodible.
Moderate seepage in substratum; will seal.	Fair stability; good material for cores.	Low intake rate; high water-holding capacity.	No problems	Slightly erodible.
Moderate seepage in substratum.	Fair stability	Moderate intake rate; high water-holding capacity.	No problems	Erodible.
Excessive seepage	Fair stability with flat slopes.	Low water-holding capacity.	Shallow to caliche	Highly erodible.
Excessive seepage	Fair stability	Low water-holding capacity.	Shallow to caliche	Erodible on flat slopes; hard to stabilize on steeper slopes.
Excessive seepage	Fair stability	High intake rate; complex slopes.	Subject to gully erosion; complex slopes.	Highly erodible.
Excessive seepage	Poor stability; can be used with proper control.	High intake rate; complex slopes.	Complex slopes; high susceptibility to wind erosion.	Highly erodible.
Permeable in substratum; will seal.	Fair stability	Low intake rate; high water-holding capacity.	No problems	Slightly erodible.

TABLE 6.—*Engineering*

Soil type	Suitability for—		Suitability as source of topsoil	Soil features affecting—
	Road subgrade	Road fill		Dikes or levees
Portales fine sandy loam (PfA, PfB)	Poor to fair	Fair	Fair	Moderately rapid permeability; fair stability.
Portales loam (PmA, PmB)	Poor to fair	Fair	Poor to fair	Moderately rapid permeability; fair stability.
Potter soils (Ps)	Poor to fair	Fair	Poor	Very shallow; moderately rapid permeability.
Pullman silty clay loam (PuA, PuB)	Poor	Fair	Fair to good	Very slow permeability; fair stability.
Randall clay (Ra)	Poor	Poor	Fair	Very slow permeability; poor stability.
Randall fine sandy loam (Rf)	Poor	Poor to fair	Fair	Very slow permeability; poor stability.
Spur clay loam (Sc)	Poor to fair	Fair	Fair to good	Moderate permeability; poor to fair stability.
Spur fine sandy loam (Sf)	Fair	Fair	Fair	Moderate permeability; fair stability.
Stamford clay (SmB)	Poor	Poor to fair	Poor	Slow permeability; fair stability if used with flat slopes.
Stamford soils (StA)	Poor	Fair	Fair	Slow permeability; fair stability if used with flat slopes.
Tivoli fine sand (Tv)	Poor	Fair	Poor	Rapid permeability; poor stability.
Travessilla fine sandy loam in the Vernon-Travessilla complex (Vb).	Poor to fair	Poor	Fair	Very shallow; rapid permeability; fair stability.
Vernon clay loam (VcB, VcD)	Poor	Poor to fair	Poor	Slow permeability; poor to fair stability.
Vernon-Travessilla complex (Vb).[2]				
Zita fine sandy loam (ZfA)	Fair	Fair	Fair	Moderate permeability; fair stability.
Zita loam (ZmA, ZmB)	Fair	Fair	Good	Moderate permeability; fair stability.

[1] See Mansker fine sandy loam for the engineering interpretations of the Mansker soil in this complex and the Potter soils for those of the Potter soil in the complex.

Field terraces and diversion terraces constructed from coarse-textured soils are difficult to maintain. Both wind and water erosion are serious hazards in maintaining terrace ridges and channels at desired specifications.

On the highly erodible soils, accumulations of windblown materials in waterways are difficult to maintain. If the permanent vegetation is covered, the water-carrying capacity of the waterway is reduced.

The mapping unit Hilly gravelly land is a possible source of sand and gravel in Crosby County. A large amount of sand and gravel has been mined in the southwestern part of the county. Some of the material underlying the Potter soils may be a possible source of hard caliche for contructing roads and surfacing them. This material occurs in limited amounts in small areas.

Cuts made in highly erodible soils, similar to the Drake soils and the Likes soil, expose material to the action of wind and water. Cut slopes in soils that have highly plastic clay layers, similar to Randall clay, are more susceptible to sloughing and sliding than other soils. Cuts made in these soils, therefore, should be on the more nearly level slopes. Seasonal floods can be a factor that will affect vertical alinement. Low-lying areas that are occasionally flooded or flooded in season may require that the pavement surface be raised so as to drain the soil and provide a firm base.

Winter grading and frost action are not considered problems, because the soils generally have a low moisture content during the winter, and subfreezing temperatures last for fairly short periods. Dispersion is not a problem in the clay soils in Crosby County.

interpretations of the soils—Continued

Soil features affecting— Farm ponds: Reservoir area	Farm ponds: Embankment	Irrigation	Field terraces and diversion terraces	Waterways
Moderate seepage	Fair stability	Moderate water-holding capacity; high intake rate.	High susceptibility to wind erosion.	Highly erodible.
Moderate seepage	Fair stability	Moderate water-holding capacity; moderate intake rate.	Subject to gully and sheet erosion.	Erodible.
Excessive seepage	Fair stability	Low water-holding capacity; very shallow.	Very shallow	Very shallow.
Permeable in substratum; will seal.	Poor to fair stability	Low intake rate; high water-holding capacity.	Subject to gully and sheet erosion.	Slightly erodible.
Practically impervious	Suitable for cores if moisture level is uniform.	Very low intake rate	No water erosion	Not applicable.
Practically impervious	Suitable for cores if moisture level is uniform.	Low intake rate	No water erosion	Not applicable.
Moderate seepage	Fair stability	High water-holding capacity; occasional flooding.	Subject to occasional flooding.	Occasional flooding.
High seepage	Fair stability	Moderately high water-holding capacity; occasional flooding.	Subject to occasional flooding.	Occasional flooding.
Low seepage	Poor stability; good core material.	High water-holding capacity; slow intake rate.	Subject to gully and sheet erosion.	Gully erosion.
Low seepage	Fair stability if used with flat slopes.	Low intake rate; high water-holding capacity.	Nearly level, low-lying areas; field terraces and diversion terraces generally not applicable.	Not applicable.
Excessive seepage	Poor stability	Very low water-holding capacity.	Duned areas; very highly susceptible to wind erosion.	Not applicable.
High seepage	Fair stability	Very low water-holding capacity.	Steep areas	Not applicable.
Low seepage	Good core material; low permeability; poor stability.	Shallow; very low intake rate.	Subject to gully and sheet erosion.	Shallow; gully erosion.
Moderate to excessive seepage.	Good to fair stability	Moderately high water-holding capacity.	High susceptibility to wind erosion.	Highly erodible.
Moderate seepage	Fair stability	High water-holding capacity; moderate intake rate.	Subject to gully and sheet erosion.	Slightly erodible.

[2] See Vernon clay loam for the engineering interpretations of the Vernon soil in this complex and the Travessilla fine sandy loam for those of the Travessilla soil in the complex.

Engineering test data

Engineering test data for samples from four soils of the Pullman, Olton, Miles, and Zita series are given in table 7. This data was furnished by the Texas State Highway Department for samples taken from 12 profiles in Crosby County. Some terms used in table 7 are discussed in the paragraphs that follow.

As moisture is removed, the volume of a soil decreases in direct proportion to the loss of moisture until a condition of equilibrium, called the *shrinkage limit*, is reached. Beyond the shrinkage limit, more moisture may be removed, but the volume of the soil will not change. Generally, the lower the number for shrinkage limit, the higher the content of clay.

Shrinkage ratio is the volume change resulting from the drying of a soil material, divided by the loss of moisture caused by drying. The ratio is expressed numerically.

Lineal shrinkage is the decrease in one dimension of the soil when the moisture content is reduced from a given percentage to the shrinkage limit (*8*). Lineal shrinkage is expressed as a percentage of the original dimension.

The *plastic limit* is the moisture content at which the soil material passes from a semisolid to a plastic state. *Liquid limit* is the moisture content at which a soil passes from a plastic to a liquid state. The *plasticity index* is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil is in a plastic condition.

TABLE 7.—*Engineering*

[Tests performed by the Texas Highway Department in accordance with standard

Soil	Parent material	Texas report number	Depth	Horizon	Shrinkage		
					Limit	Ratio	Lineal
			Inches				
Miles fine sandy loam:							
1.9 miles N. of Garza County and 1.0 mile E. and 0.2 mile N. of Farm Road 122. (Modal profile.)	Sandy terrestrial deposits.	61–524–R	0–8	Ap	15	1. 81	3. 6
		61–525–R	18–30	B22	14	1. 87	10. 6
		61–526–R	46–72	Cca	13	1. 89	6. 8
		61–527–R	72–96	C	16	1. 83	6. 2
9 miles SE. of Crosbyton. (No Cca horizon.)	Sandy terrestrial deposits.	61–519–R	0–7	A1	13	1. 86	4. 4
		61–520–R	14–38	B22	13	1. 89	10. 6
0.5 mile N. and 100 feet W. of Kalgary. (Deeper Cca horizon.)	Sandy terrestrial deposits.	61–521–R	0–12	Ap	14	1. 78	2. 2
		61–522–R	24–38	B22	14	1. 89	7. 9
		61–523–R	64–74	Cca	13	1. 90	3. 2
Olton loam:							
0.55 mile N. of Farm Road 40 and 100 feet W. of Farm Road 122. (Modal profile.)	Fine-textured sediment, probably wind deposited.	61–515–R	0–6	Ap	13	1. 91	10. 2
		61–516–R	16–28	B22	13	1. 90	12. 2
		61–517–R	40–56	Cca	11	1. 98	9. 0
		61–518–R	56–72+	C	11	2. 01	10. 2
100 feet E. and 4.05 miles S. of Crosbyton on Farm Road 651. (Clayey B2 horizon.)	Fine-textured sediment, probably wind deposited.	61–510–R	0–7	Ap	14	1. 86	8. 9
		61–511–R	13–25	B22	13	1. 95	15. 3
		61–512–R	38–50	Cca	13	1. 92	10. 4
50 feet W., 0.3 mile E., and 1 mile S. of Savage. (Deeper Cca horizon.)	Fine-textured sediment probably wind deposited.	61–513–R	0–7	Ap	13	1. 89	6. 5
		61–514–R	15–25	B22	12	1. 93	12. 0
Pullman silty clay loam:							
5.55 miles NE. of U.S. Highway No. 82 and 100 feet NW., on Farm Road 2591. (Modal profile.)	Fine-textured sediment of eolian origin.	61–500–R	0–6	Ap	13	1. 90	11. 8
		61–501–R	12–22	B22	10	1. 98	17. 2
		61–502–R	38–52	Cca	15	1. 89	10. 0
		61–503–R	52–74+	C	15	1. 90	10. 3
3.6 miles NE. of U.S. Highway No. 82, 1.0 mile E.; 1.05 mile N. and 50 feet W. of Farm Road 2561. (Shallow to Cca horizon.)	Fine-textured sediment of eolian origin.	61–504–R	0–6	Ap	15	1. 90	10. 6
		61–505–R	12–20	B22	13	1. 94	14. 4
		61–506–R	32–50	Cca	14	1. 89	11. 5
175 feet S. and 0.3 mile W. of Fairview School. (Deeper Cca horizon.)	Fine-textured sediment of eolian origin.	61–507–R	0–8	Ap	14	1. 89	8. 5
		61–508–R	18–26	B22	12	1. 98	14. 8
		61–509–R	48–64	Cca	14	1. 90	11. 9
Zita loam:							
1.3 miles W. and 1.1 miles S. of Owens. (Modal profile.)	Highly calcareous, chalky material.	61–528–R	0–8	Alp	14	1. 86	5. 8
		61–529–R	16–33	AC	13	1. 88	12. 7
		61–530–R	33–58	Cca	17	1. 83	7. 5
0.55 mile E. of Farm Road 122 and 0.85 mile S. and 50 feet E. of Farm Road 40. (Clayey AC horizon.)	Highly calcareous, chalky material	61–531–R	0–8	Ap	14	1. 88	7. 1
		61–532–R	18–32	AC	13	1. 90	12. 8
0.55 mile E. of Farm Road 122, 0.6 mile S. and 0.1 mile E. and 50 feet N. of Farm Road 40. (Limy AC horizon.)	Highly calcareous, chalky material.	61–533–R	0–7	Ap	14	1. 87	5. 8
		61–534–R	17–34	AC	12	1. 95	14. 2

[1]Mechanical analysis according to the AASHO Designation: T 88–57 (*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material

test data

procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis[1]									Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—						
1-in.	¾-in.	No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.			AASHO	Unified[2]
----	----	----	100	96	31	25	17	15	21	4	A–2–4(0)	SM–SC.
----	----	----	100	97	57	52	35	32	36	21	A–6(9)	CL.
----	100	95	93	91	50	43	28	21	26	12	A–6(4)	SC.
----	100	98	97	96	58	50	25	20	28	12	A–6(5)	CL.
----	----	----	100	88	33	28	14	11	21	6	A–2–4(0)	SM–SC.
----	----	----	100	90	48	42	29	25	35	20	A–6(6)	SC.
----	----	----	100	91	24	18	8	7	18	2	A–2–4(0)	SM.
----	----	----	100	92	49	41	24	22	28	15	A–6(5)	SC.
100	99	94	90	82	29	24	16	11	19	4	A–2–4(0)	SM–SC.
----	----	----	----	100	70	60	34	27	33	18	A–6(10)	CL.
----	----	----	100	99	70	62	37	34	39	23	A–6(12)	CL.
----	100	96	94	94	63	54	34	29	28	16	A–6(8)	CL.
100	99	95	94	92	66	57	40	30	30	18	A–6(9)	CL.
----	----	----	100	99	77	63	28	21	31	16	A–6(10)	CL.
----	----	----	100	98	80	73	47	40	46	27	A–7–6(16)	CL.
----	100	94	91	89	71	65	48	36	34	19	A–6(11)	CL.
----	----	----	----	100	60	48	24	21	25	12	A–6(6)	CL.
----	----	----	100	99	69	60	37	33	37	23	A–6(12)	CL.
----	----	----	----	100	81	70	35	30	37	20	A–6(12)	CL.
----	----	----	100	98	84	77	48	42	49	30	A–7–6(18)	CL.
----	100	97	95	94	81	76	59	42	35	20	A–6(12)	CL.
----	100	96	94	92	79	73	59	43	35	20	A–6(12)	CL.
----	----	----	100	99	74	62	34	29	36	20	A–6(12)	CL.
----	----	----	100	97	78	71	43	40	43	26	A–7–6(15)	CL.
----	100	94	92	90	73	66	46	36	38	23	A–6(13)	CL.
----	----	----	----	100	73	64	32	29	30	16	A–6(10)	CL.
----	----	----	100	99	80	74	46	41	44	27	A–7–6(16)	CL.
----	100	98	97	96	80	75	54	42	38	23	A–6(13)	CL.
----	----	----	----	100	51	43	21	17	25	9	A–4(3)	CL.
----	----	----	100	96	66	62	39	33	40	24	A–6(12)	CL.
----	100	92	85	80	60	58	42	31	31	16	A–6(7)	CL.
----	----	----	100	99	54	48	26	22	27	13	A–6(5)	CL.
----	----	----	100	98	69	62	42	38	40	23	A–6(12)	CL.
----	----	----	----	100	56	44	23	17	25	10	A–4(4)	CL.
----	100	99	98	96	70	62	43	36	42	25	A–7–6(13)	CL.

coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

[2] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points from A-line are to be given a borderline classification. An example of a borderline classification obtained by this use is SM–SC.

Formation and Classification of Soils

In this section the factors of soil formation are discussed, and the outstanding morphologic characteristics of the soils and their relationship to the factors of soil formation are given. Also discussed is the classification of the soils by higher categories. Each soil series is briefly described, and a typical profile for the series and the variations within the series are given.

Complete physical and chemical data are not available for the soils, and the discussion of classification and morphology is therefore incomplete.

Factors of Soil Formation

The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate in which the soil material has accumulated and in which the soil-forming processes have taken place, (3) living organisms, or the plant and animal life in and on the soil, (4) the relief, or lay of the land, and (5) the length of time in which the various changes have occurred.

Climate and living organisms are the active factors of soil formation. They act on the parent material accumulated by the weathering of rock and unconsolidated deposits and slowly change it into a natural body with genetically related horizons. The effects of climate and living organisms are conditioned by relief. The parent material also affects the kind of profile that can be formed and in extreme cases determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. The amount of time may be much or little, but generally a long time is required for distinct horizons to develop in a soil.

The interrelationship among the five factors of soil formation is complex, and the effect of any one factor is difficult to isolate. Each factor is discussed separately in the paragraphs that follow, but it is the interaction of all these factors, rather than their simple sum, that determines the nature of the soil profile.

Parent material.—All the soils on the High Plains in Crosby County formed in outwash of the Quaternary or late Tertiary age. The parent material consists mainly of alkaline to calcareous, unconsolidated, sandy and silty material. This outwash has been reworked by wind or affected by a high water table many times since it was deposited.

Wind sorting has removed most of the silt and clay from the parent material of some of the sandy Amarillo and Brownfield soils. Consequently, these soils are generally lower in carbonates and higher in silica than those that contain more clayey material.

On the other hand, such soils as the Pullman and Olton series, derived from fine-textured material, generally develop more rapidly than those derived from coarse-textured sand. Also, their horizons are more clearly defined.

Some soils that contain much calcium carbonate formed on the leeward sides of basins in playas. Here calcium carbonate, precipitated from water in the lake basins, was redeposited by wind on the eastern sides of some of the lakes. Soils that formed in these kinds of materials are of the Drake and Portales series.

The soils of the Rolling Plains formed from four different kinds of parent material (1) alluvial outwash, (2) material from red beds of the Triassic and Permian ages, (3) recent deposits of alluvium, and (4) wind-laid sands. Most of the soils of the Rolling Plains formed from a rather thick mantle of alluvial outwash similar to the parent material of the soils of the High Plains. Some soils of the Rolling Plains that formed from this material are the Miles, Abilene, and Brownfield soils.

Smaller, scattered areas of clayey soils, such as the Stamford and Vernon soils, formed from material derived from the exposed red beds of the Triassic and Permian ages.

The parent material of soils on the flood plains of the rivers and drainageways of the county consists of recent deposits of alluvium. Many of these deposits on lower lying flood plains have been reworked from time to time, and new sediments have been deposited. Soils formed in deposits of alluvium are those of the Spur series.

A thick mantle of wind-laid sand covers some areas along the White and Brazos Rivers. This sand has been blown from channels of rivers that drain parts of the High Plains of the county. Soils of the Tivoli series formed from this sandy material.

Climate.—The subhumid, warm-temperate, continental climate of Crosby County has had a marked effect on the formation of the soils. The wide variations in temperatures caused the parent rock and soil material to fracture as a result of expansion that occurs at high temperatures and contraction that occurs at low temperatures and thus hastens weathering. In addition, freezing has had some effect on weathering.

Most of the soils have a horizon of calcium carbonate. This horizon formed mainly because rainfall is limited and seldom wets the soil below the area of living roots. Many of the soils have a clayey subsoil, because even though the amount of water that moves through the soil is small, it carries clay particles downward from the surface layer and deposits them as the movement of the water slows. As clay accumulates, the water moves even slower and deposition of clay accelerates. Thus, the process tends to speed up and eventually the subsoil becomes clayey.

Wind also affects the formation of soils in the county. It has affected soil formation from the time it deposited sand over preexisting alluvial materials in the Illinoian stage of the Pleistocene to its present shifting of coarse sand on the surface of the soils (*5*).

Living organisms.—Before settlement of the county, the native vegetation was most important in the complex of living organisms that affect soil formation. The first settlers found mainly short and mid grasses on the moderately fine textured soils. Tall bunch grasses grew on the moderately coarse and coarse textured soils. Large amounts of organic matter were incorporated into the soil from the growth of these grasses. The organic matter came largely from the decomposition of litter from the leaves and stems of the grasses and from their roots. The roots of the plants also made the soil more porous and open to water as they moved downward through the soils.

Decay of the leaves, stems, and roots was brought about by the many micro-organisms and bacteria in the soil. Of the many other forms of life that begin working and churning the soils once they have been enriched with organic matter, earthworms are the most noticeable. Despite the low rainfall in the area and periods when the

entire solum is dry, the importance of earthworms in soil development is easily seen. Worm casts and channels in the Amarillo, Zita, and Miles soils, for example, occupy about 50 percent of the subsoil. They do much to help air, water, and plant roots to move through the soil.

Soil-dwelling rodents have had a part in the development of some soils. Farmers who occupied the land since it was in native grass know where large prairie-dog towns thrived. The burrowing of these animals did much to offset the leaching of free lime from the soil and destroyed soil structure that was already formed.

The influence of men on soil formation should not be ignored. At first men fenced the range, stocked it with cattle, and permitted it to be overgrazed. They then plowed the land and planted crops. By harvesting crops and allowing runoff and wind erosion, they reduced the amount of organic matter and the proportion of silt and clay particles in the plow layer. Through the use of heavy machinery and poorly timed tillage, men made compacted areas that reduced the movement of water, air, and plant roots through the soil. By irrigating, they drastically changed the amount of moisture available in some areas. The things that men have done in the past 60 years have had marked effects on the soils of the county, and the way that they manage the soil in future generations will affect its further development.

Relief.—Relief, or lay of the land, helps to determine the kind of soil that develops by affecting the nature of the parent material accumulated, the drainage, the amount and kind of organic matter accumulated in the surface layer, the soil depth, and the degree of horizon differentiation.

The High Plains part of the county consists of a nearly level to gently sloping plain. Except for two small areas in the north-central part of the county that are drained by Crawfish Creek and the White River, drainage is to the southeast into playa basins.

In general, the nearly level soils on plains or in slight depressions of the High Plains have a darker surface layer than the gently sloping ones. They absorb much of the rain that falls. The additional moisture encourages growth of plants and hastens their decomposition. Consequently, more organic matter is added to the soil, and the horizons in the profile are more distinct. The gently sloping soils generally have less distinct horizons than the nearly level soils. Furthermore, in some of the gently sloping areas, erosion removes the soil material faster than soil horizons can develop.

Most of the area in the Rolling Plains below the caprock escarpment is drained by the White and Brazos Rivers and their tributaries. Here, because of the steep slope, the soils form slowly and most of them are shallow. Erosion is severe and removes the soil material faster than a soil profile can develop. Only those soils in valleys and on smoother ridges have distinct soil horizons.

Time.—The length of time required for a soil to come into equilibrium with its environment, or reach maturity, depends on the action of the soil-forming factors and the intensity of the action. The soils of Crosby County differ in degree of formation, because their parent materials are different, and they were exposed to soil-forming processes at different times.

In this county the climate is dry, and the vegetation is fairly sparse. The effects of the climate and vegetation on the soil material is slow. A long time is therefore needed for a soil to reach maturity. Mature soils show marked horizon differentiation. The Pullman, Olton, and Abilene soils are examples of such soils.

Some materials that have been in place for only a short time have not been influenced enough by climate and living organisms to form well-drained and genetically related horizons. Such soils are said to be young soils. The Berthoud, Mansker, and Bippus are examples of young soils.

Classification of the Soils by Higher Categories

In the system of soil classification now being used in the United States, the soils are placed in six categories, one above the other. Beginning at the top, the six categories in the system of soil classification are order, suborder, great soil group, family, series, and type. The categories of suborder and family have never been fully developed and, therefore, have been little used (*9, 10*).

The lower categories of classification, the soil series, type, and phase, are defined in the section "How This Survey Was Made." The soil series are classified into higher categories—great soil group and soil orders. In a great soil group are soils that have fundamental characteristics in common. All three soil orders—the zonal, intrazonal, and azonal—are represented in this county.

Zonal soils have well-developed characteristics that reflect the influence of the active factors of soil formation—climate and living organisms, chiefly vegetation. In this county, most of the well-drained soils have well-defined horizons and formed under grass in warm-temperate subhumid climate. Thus, they are classified as zonal soils. In Crosby County the Reddish Brown soils, Chestnut soils, and Reddish Chestnut soils are the great soil groups in the zonal order.

Reddish brown soils formed under a cover of bunch grass and scattered shrubs. Their surface soil is typically light-colored loose sand. The upper part of the subsoil is heavier in texture and is red to reddish brown in color. It grades to a less clayey, neutral horizon. The fertility of these soils is relatively low. Soils in the Brownfield series are in this great soil group.

Chestnut soils formed under short to mid grasses. The surface soil is brown to dark grayish brown. It grades to a lighter colored horizon and then to a white, pink, or yellowish, calcareous horizon at a depth of 22 to 48 inches. The fertility is high, but growth of crops under dryland farming is limited by the low rainfall and the high rate of evaporation. Soils in the Abilene, Bippus, Lofton, Pullman, and Zita series are in this great soil group.

Reddish Chestnut soils formed under a mixed cover of shrubs and grasses. The surface soil is reddish brown and friable. The upper part of the subsoil is reddish brown to red and is heavier and tougher than the surface soil. The lower part of the subsoil is highly calcareous. These soils are fairly high in fertility, but growth of crops under dryland farming is limited by the low rainfall and the high rate of evaporation. Soils in the Amarillo, Miles, and Olton series are in the Reddish Chestnut group.

Intrazonal soils have more or less well-developed characteristics that reflect the dominating influence of some local factor of relief or parent material over the normal effect of climate and vegetation. In this county the great

soil groups in the azonal order are the Calcisols and Grumusols.

Calcisols (*6*) formed in a subhumid climate where leaching is limited. The dominant vegetation was a sparse cover of short grass and shrubs. Calcisols are moderately low in fertility. The surface soil is reddish brown to grayish brown and is friable. The subsoil is friable and highly calcareous. As much as 70 percent of the volume is calcium carbonate. In this county the soils of the Mansker and Portales series are in this great soil group.

Grumusols (*7*) are dark clays that formed in widely variable climates, generally where wet and dry seasons alternate. Their surface layer and subsoil are both calcareous clay that has blocky structure. The clay shrinks and swells as the soils are made wet and dry. In this county only the soils of the Randall series are in the Grumusol great soil group.

Azonal soils are soils that, because of youth, resistant parent material, or steepness, lack well-developed profiles. In this county the Alluvial soils, Lithosols, and Regosols are the great soil groups in the azonal order.

Alluvial soils are forming in materials transported and recently deposited on flood plains. Each time the areas are flooded, the soils receive fresh deposits of soil material, or part of the old surface material is removed. As a result, the original material has not been modified or is only weakly modified by soil-forming processes. In this county only the soils of the Spur series are in this great soil group.

Lithosols have an incomplete solum or little or no profile development. They consist of freshly and imperfectly weathered rock fragments, or cemented caliche, and are mainly on steep slopes. In Crosby County the highly calcareous soils of the Potter, Travessilla, and Vernon series are in this great soil group.

Regosols consist of moderately deep to deep, unconsolidated, soft, mineral deposits in which there are few or no clearly expressed soil characteristics. In Crosby County the soils of the Berthoud, Drake, Likes, Stamford, and Tivoli series are in this great soil group.

The classification of soil series in Crosby County into great soil groups is shown in the following tabulation.

Order and great soil group	*Series*
Zonal—	
Reddish Brown	Brownfield.
Chestnut	Abilene, Bippus, Lofton, Pullman, Zita.
Reddish Chestnut	Amarillo, Miles, Olton.
Intrazonal—	
Calcisols	Mansker, Portales.
Grumusols	Randall.
Azonal -	
Alluvial soils	Spur.
Lithosols	Potter, Travessilla, Vernon.
Regosols	Berthoud, Drake, Likes, Stamford, Tivoli.

Detailed Descriptions of Soil Series

In the following pages, the soil series in the county are described in alphabetical order. A detailed profile typical of a soil type in each series is a part of each description. The variations for each series are mentioned after the profile description. The soil descriptions are based on information obtained by examining the soils in the field.

In this section the color of the soil is indicated in two ways. First, it is indicated by a descriptive term, such as dark brown. Second, it is also indicated by a Munsell notation, such as (7.5YR 4/4). The Munsell notation denotes color more precisely than is possible by the use of words. Unless otherwise stated, the color given is that of a dry soil.

ABILENE SERIES

In the Abilene series are deep, well-drained, brown to dark grayish-brown, nearly level soils of the upland. These soils are members of the Chestnut great soil group. They formed in valleys from unconsolidated, loamy, calcareous, water-laid deposits of the Quaternary or Tertiary period. The native vegetation was mid and short grasses.

Abilene soils are darker than the Miles soils and are less sandy throughout. Except that they are less red, they are similar to the Olton soils of the High Plains.

Typical profile of Abilene clay loam in a pasture (3.0 miles east of Kalgary, Tex., on Farm Road 261, and 0.3 mile north):

A1—0 to 7 inches, dark-brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/4) moist; weak, subangular blocky structure; hard when dry, friable when moist; noncalcareous; pH 7.5; many, very fine, and fine pores; a few worm casts and roots; clear boundary.

B21t—7 to 22 inches, dark-brown (7.5YR 4/2) heavy clay loam, dark reddish brown (5YR 3/2) moist; strong, medium, blocky structure; very hard when dry, firm when moist; noncalcareous; pH 7.5; discontinuous, patchy clay films; a few very fine pores; a few roots and fine, waterworn pebbles; gradual boundary.

B22t—22 to 38 inches, dark-brown (7.5YR 4/3) heavy clay loam, dark brown (7.5YR 3/3) moist; strong, medium, blocky structure; very hard when dry, firm when moist; strongly calcareous; pH 7.8; a few, fine, hard concretions of calcium carbonate; discontinuous, patchy clay films; gradual boundary.

Bca—38 to 46 inches, reddish-yellow (7.5YR 6/6) heavy clay loam, strong brown (7.5YR 5/6) moist; very firm when moist; strongly calcareous; common, fine, hard concretions of calcium carbonate; gradual boundary.

Cca—46 to 60 inches +, reddish-yellow (7.5YR 7/6) clay loam, reddish yellow (7.5YR 6/6) moist; very hard when dry; very strongly calcareous; about 50 percent of the soil mass by volume consists of many soft and hard concretions of calcium carbonate.

The A horizon ranges in color from brown to dark grayish brown, in hue from 7.5YR to 10YR, and in thickness from 4 to 8 inches. In places this horizon is calcareous.

The B horizon ranges in color from brown to dark grayish brown, in hue from 7.5YR to 10YR, and in thickness from 22 to 55 inches. Its texture ranges from heavy clay loam or light clay in the B2 horizon to sandy clay loam in the Bca horizon. The structure ranges from strong, medium, subangular blocky to strong, medium or fine, blocky. A B3 horizon is present in some places. Depth to the Cca horizon ranges from 26 to 58 inches.

AMARILLO SERIES

The Amarillo series consists of deep, brown to reddish-brown, well-drained soils of the upland. These soils belong to the Reddish Chestnut great soil group. They are nearly level to gently sloping and are in the southwestern part of the county. Amarillo soils probably formed from eolian sediment laid down on calcareous Tertiary deposits. The native vegetation was mid and tall grasses.

The Amarillo soils have a thicker solum and a less clayey subsoil than the Mansker soils. Their B horizon is less

clayey and less blocky than that of the Olton soils. Their subsoil is redder and less calcareous than that of the Zita soils and is less dark and clayey than that of the Lubbock. In contrast to the Brownfield soils, Amarillo soils are less sandy and have a thinner A horizon. Also, they have more calcium carbonate in the C horizon.

Typical profile of Amarillo fine sandy loam in a cultivated field (1.7 miles east and 200 feet north of Robertson):

Ap—0 to 10 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/4) moist; weak, granular structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt boundary.

B2t—10 to 25 inches, reddish-brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) moist; compound moderate, very coarse, prismatic and weak, subangular blocky structure; very hard when dry, friable when moist; common, fine pores and worm casts; noncalcareous; discontinuous, patchy clay films; gradual boundary.

B3—25 to 38 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; compound weak, very coarse, prismatic and subangular blocky structure; very hard when dry, friable when moist; many very fine pores; weakly calcareous; discontinuous, patchy clay films; diffuse boundary.

Cca—38 to 52 inches, pinkish-white (7.5YR 8/2) sandy clay loam, pinkish gray (7.5YR 7/2) moist; about 40 percent by volume consists of calcium carbonate equivalent; many fine and hard concretions of calcium carbonate; very strongly calcareous; diffuse boundary.

C—52 to 66 inches +, yellowish-red (5YR 5/6) sandy clay loam, (5YR 4/6) moist; 15 percent by volume consists of calcium carbonate equivalent; very strongly calcareous.

The A horizon ranges in color from brown to reddish brown, in hue from 5YR to 7.5YR, and in texture from fine sandy loam to loamy fine sand. The A horizon of the fine sandy loams ranges from 6 to 12 inches in thickness, but that of the loamy fine sands ranges from 12 to 20 inches.

The color of the B2 horizon varies only slightly from reddish brown, hue 5YR. This horizon has a texture of sandy clay loam or light clay loam. Its structure ranges from moderate, very coarse, prismatic to weak or moderate, fine to medium, subangular blocky, and its thickness, from 12 to 25 inches.

The B3 horizon ranges in color from reddish brown to yellowish red, hue 5YR. The structure of this horizon ranges from weak, very coarse, prismatic to subangular blocky, or granular. The thickness ranges from 10 to 40 inches. In places the upper part of this horizon is noncalcareous. In some places a B1 horizon is present.

The Cca horizon ranges in color from pinkish white to reddish yellow. Its texture ranges from sandy clay loam to light clay loam. The consistence is generally soft, but it ranges to moderately cemented. Depth to the Cca horizon ranges from 30 to 77 inches.

The C horizon ranges in color from reddish yellow to yellowish red. Its texture is sandy clay loam.

BERTHOUD SERIES

In the Berthoud series are deep, dark, calcareous, moderately sloping to sloping soils of the upland. These soils belong to the Regosol great soil group. They formed in highly calcareous fine sandy loam and loam washed from the Quaternary and Tertiary deposits below the caprock escarpment. The native vegetation was mid and tall grasses.

These soils have a thicker solum than the Mansker and Potter soils. Their surface layer is dark to less depth than that of the Bippus soils.

Typical profile of Berthoud fine sandy loam in a pasture (1.0 mile east on U.S. Highway No. 82 from Farm Road 2591, and then 50 feet north):

A1—0 to 10 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak, prismatic structure; slightly hard when dry, very friable when moist; weakly calcareous; common roots; common worm casts; many very fine pores; a few, fine, hard concretions of calcium carbonate; gradual boundary.

AC—10 to 30 inches, pale-brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, subangular blocky structure; hard when dry, friable when moist; strongly calcareous; common, fine concretions of calcium carbonate; a few threads and films of calcium carbonate between peds; common worm casts; gradual boundary.

C—30 to 60 inches +, pink (7.5YR 7/4) fine sandy loam, brown (7.5YR 5/4) moist; weak, granular structure; slightly hard when dry, very friable when moist; strongly calcareous; a few, hard, fine concretions of calcium carbonate; a few to common pores.

The A horizon ranges in color from very pale brown to dark brown and in hue from 7.5YR to 10YR. Its texture ranges from fine sandy loam to loam and its thickness from 5 to 12 inches. This horizon ranges from noncalcareous to strongly calcareous.

The AC horizon ranges in color from very pale brown to light brown, in hue from 7.5YR to 10YR, and in texture from fine sandy loam to loam. The structure ranges from weak, granular, prismatic to subangular blocky. This horizon ranges from strongly calcareous to very strongly calcareous. In places there is an inconspicuous Cca horizon. Depth to the C horizon ranges from 17 to 42 inches.

BIPPUS SERIES

In the Bippus series are deep, dark, friable, gently sloping to moderately sloping soils of the upland. These soils occupy areas below the caprock escarpment. They are in the Chestnut great soil group. Bippus soils formed in calcareous loam, sandy loam, and clay loam washed from Quaternary and Tertiary deposits. The native vegetation was mid and short grasses.

Bippus soils have a thicker and darker A horizon than the Berthoud soils. They are similar to the Mansker soils but have a thicker solum and a less distinct Cca horizon. They differ from the Spur soils in having formed in older material above the alluvial flood plains.

Typical profile of Bippus clay loam in a pasture (3.0 miles south of Crosbyton on Farm Road 651, 4.25 miles east-southeast, and 0.15 mile southwest):

A1—0 to 14 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; compound moderate, medium, granular and weak, coarse, prismatic structure; slightly hard when dry, friable when moist; many fine pores and worm casts; strongly calcareous; gradual boundary.

AC—14 to 41 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; weak, prismatic and subangular blocky structure; hard when dry, friable when moist; many fine pores and worm casts; very strongly calcareous; common, fine and very fine concretions of calcium carbonate; gradual boundary.

C—41 to 60 inches +, light-brown (7.5YR 6/4) light clay loam, brown (7.5YR 5/4) moist; weak, granular structure; hard when dry, friable when moist; few, fine and medium concretions of calcium carbonate; many films and threads of calcium carbonate; very strongly calcareous.

The A horizon ranges in color from brown to dark grayish brown, in hue from 7.5YR to 10YR, and in thickness from 11 to 20 inches. It ranges from noncalcareous to strongly calcareous. The AC horizon ranges in color from very pale brown to dark brown and in hue from 7.5YR to 10YR. Its texture ranges from loam to clay loam and its thickness from 10 to 30 inches. This horizon ranges from weakly calcareous to very strongly calcareous. Depth to the C horizon ranges from 21 to 50 inches.

BROWNFIELD SERIES

The Brownfield series consists of gently sloping, light-colored, deep sands of the upland. These soils belong to the Reddish Brown great soil group. In the west-central part of the county, Brownfield soils probably formed in alluvial outwash over Tertiary deposits, but in the southeastern part, they formed in material overlying Triassic red beds. This outwash from alluvium probably was reworked by wind many times since it was laid down. The native vegetation was tall grasses.

Brownfield soils are similar to the Amarillo and Miles soils, but they have a thicker and sandier surface layer. They have a sandier surface layer and a more clayey subsoil than the Likes soils. Their subsoil is redder and more clayey than that of the Tivoli soils.

Typical profile of Brownfield fine sand in a pasture (0.7 mile west on Farm Road 261 from the Dickens County line, 4.0 miles north, 0.8 mile east, and 0.8 mile north) :

A1—0 to 8 inches, brown (10YR 5/3) fine sand, dark brown (10YR 3/3) moist; single grain; loose when dry or moist; many roots; noncalcareous; pH 7.0; gradual boundary.

A2—8 to 22 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 4/3) moist; single grain; loose when dry or moist; many roots; noncalcareous; pH 6.5; clear boundary.

B2t—22 to 30 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate, medium, subangular blocky structure; very hard when dry, friable when moist; porous; noncalcareous; pH 6.8; gradual boundary.

B3—30 to 52 inches, reddish-yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 4/6) moist; moderate, medium, subangular blocky structure; soft when dry, friable when moist; noncalcareous; pH 6.8; gradual boundary.

C—52 to 70 inches +, reddish-yellow (5YR 6/8) loamy fine sand, yellowish red (5YR 5/6) moist; slightly hard when dry; noncalcareous.

The A1 horizon ranges in color from pale brown to brown, in hue from 7.5YR to 10YR, and in thickness from 5 to about 12 inches.

The A2 horizon ranges in color from pale brown to very pale brown and in hue from 7.5YR to 10YR. Its thickness ranges from 10 to 30 inches. This horizon ranges from slightly acid to neutral. In cultivated areas the A2 horizon is obscured, and the plow layer is generally a mixture of the upper two horizons.

The B horizon ranges in color from red to yellowish red, in hue from 2.5YR to 5YR, and in thickness from 25 to 40 inches. The texture ranges from sandy clay loam in the upper part of the B horizon to fine sandy loam in the B3 horizon. The structure of the B horizon ranges from moderate, coarse, prismatic to moderate, medium, subangular blocky. Depth to the C horizon ranges from 40 to 82 inches.

DRAKE SERIES

In the Drake series are gently sloping to moderately sloping, moderately deep, grayish-brown limy soils of the upland. These soils are on the lee sides of some of the basins of large, enclosed playas, mostly in the western part of the county. They are in the Regosol great soil group. Drake soils formed under mid and tall grasses from loam or clay loam, probably of eolian origin.

Drake soils are more friable than the Mansker soils and contain fewer segregated concretions of calcium carbonate. Their surface layer is more calcareous than that of the Portales soils.

Typical profile of Drake clay loam in a cultivated field (3.0 miles north of U.S. Highway No. 82 on Farm Road 2236, and 60 feet east) :

Ap—0 to 8 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak, granular structure; slightly hard when dry, friable when moist; very strongly calcareous; abrupt, smooth boundary.

AC—8 to 30 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; weak, coarse, prismatic and weak, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist; common worm casts and fine pores; a few soft concretions of calcium carbonate; very strongly calcareous; diffuse, wavy boundary.

C—30 to 56 inches, very pale brown (10YR 8/3) light clay loam; pale brown (10YR 6/3) moist; structureless; slightly hard when dry, friable when moist; very strongly calcareous.

The A horizon ranges in color from grayish brown to light brownish gray, hue 10YR, and in thickness from 5 to 11 inches. The AC horizon is light brownish gray and ranges in thickness from 11 to 25 inches. Depth to the C horizon ranges from 16 to 36 inches. The C horizon on the crest of the slope is generally light gray to a depth of 60 inches or more. Along the outer limits of the areas, the color is light brown to a depth of 36 inches or less.

LIKES SERIES

The Likes series consists of light-colored, moderately sloping, sandy soils. These soils are on alluvial fans and foot slopes of the upland. They are in the Regosol great soil group. Likes soils formed under tall grasses from unconsolidated sand from the Ogallala formation.

The Likes soils have a less red surface layer and a less clayey subsoil than the Miles and Amarillo soils. They are sandier throughout than the Berthoud soils, but they have a less sandy surface layer than the Tivoli soils. The Likes soils have a more sandy subsoil than the Brownfield soils.

Typical profile of Likes loamy fine sand in a pasture (3.0 miles south of Crosbyton on Farm Road 651, 5.0 miles east and southeast, 0.5 mile northeast, and 0.15 mile west) :

A1—0 to 10 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; structureless; single grain; loose when dry and moist; noncalcareous; pH 8.0; a few quartz pebbles; gradual boundary.

AC—10 to 30 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; structureless; single grain; loose when dry and moist; weakly calcareous; pH 8.1; a few fine concretions of calcium carbonate; gradual boundary.

C—30 to 50 inches +, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; structureless; single grain; loose when dry and moist; strongly calcareous.

The A horizon ranges in color from pale brown to dark brown, in hue from 7.5YR to 10YR, and in thickness from

8 to 20 inches. It ranges from noncalcareous to weakly calcareous. The AC horizon ranges in color from pale brown to very pale brown and in hue from 7.5YR to 10YR. It ranges in texture from fine sandy loam to loamy fine sand or very fine sand. Its thickness ranges from 10 to 28 inches. Depth to the C horizon ranges from 18 to 48 inches.

LOFTON SERIES

In the Lofton series are deep, gray-colored soils of the upland, mostly on first benches on the eastern side of playas. These soils belong to the Chestnut great soil group. They formed under short grasses in wind-laid or water-laid material from silty and sandy clays, probably during the Quaternary era.

Lofton soils are browner throughout the profile than the Randall soils and have a less clayey surface layer. They are darker to a greater depth than the Pullman and Olton soils and occupy lower areas.

Typical profile of Lofton clay loam in a pasture (0.7 mile east of intersection of U.S. Highway No. 82 and Farm Road 28, and 200 feet south):

A1—0 to 6 inches, dark grayish-brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; noncalcareous; many roots; clear boundary.

B21t—6 to 18 inches, dark grayish-brown (10YR 4/2) clay, very dark brown (10YR 2/2) moist; moderate, medium, blocky structure; extremely hard when dry, very firm when moist; patchy, almost continuous clay films; noncalcareous; a few pores and roots; clear boundary.

B22t—18 to 34 inches, brown (7.5YR 5/3) clay, dark brown (7.5YR 4/3) moist; moderate, fine and medium, blocky structure; extremely hard when dry, very firm when moist; strongly calcareous; soft spots of calcium carbonate between peds; discontinuous, patchy clay films; gradual boundary.

Cca—34 to 46 inches, light-brown (7.5YR 6/4) clay, brown (7.5YR 5/4) moist; weak, blocky structure; very hard when dry, very firm when moist; very strongly calcareous; common, soft and hard concretions of calcium carbonate; diffuse boundary.

C—46 to 60 inches +, yellowish-red (5YR 5/6) silty clay loam, yellowish red (5YR 4/6) moist; very hard when dry, very firm when moist; strongly calcareous; a few segregated, soft concretions of calcium carbonate.

The A horizon ranges in color from pale brown to dark grayish brown, hue 10YR, and in structure from weak, granular to subangular blocky. Its texture ranges from fine sandy loam to clay loam and its thickness from 6 to 15 inches. The B horizon ranges in color from light brown to dark grayish brown, in hue from 7.5YR to 10YR, and in thickness from 20 to 52 inches. Depth to parent material ranges from 26 to 68 inches. In some areas the Cca horizon is lacking.

MANSKER SERIES

The Mansker series consists of dark, calcareous soils of the upland. These soils belong to the Calcisol great soil group. They formed under short and mid grasses in strongly calcareous loam and clay loam, probably derived from Tertiary sediments. The Mansker soils occupy small, irregular areas within areas of the level Amarillo, Olton, and Miles soils; sloping areas around basins in playas; and irregular areas throughout the southeastern part of the county.

These soils somewhat resemble the Potter soils, but their solum is 10 to 22 inches thick rather than 4 to 10 inches thick. They are shallower than the Amarillo, Miles, and Portales soils. Also, they are more calcareous than the Amarillo and Miles soils.

Typical profile of Mansker fine sandy loam in a cultivated field (0.5 mile east of Kalgary on Farm Road 651, and 0.75 mile north):

Ap—0 to 7 inches, brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 3/3) moist; weak, granular structure; slightly hard when dry, very friable when moist; strongly calcareous; pH 8.0; a few, fine, hard concretions of calcium carbonate; a few fine roots; gradual boundary.

AC—7 to 14 inches, light-brown (7.5YR 6/3) clay loam, brown (7.5YR 4/3) moist; weak, coarse, prismatic and granular structure; hard when dry, friable when moist; very strongly calcareous; pH 8.2; common, hard concretions of calcium carbonate; common, soft lumps of disseminated calcium carbonate; many very fine roots; common worm casts; gradual boundary.

Cca—14 to 26 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist, weak, coarse, prismatic and granular structure; hard when dry, friable when moist; very strongly calcareous; pH 8.3; many, fine to medium, hard concretions of calcium carbonate.

C—26 to 35 inches +, reddish-yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; very friable when moist; strongly calcareous.

The A horizon ranges in color from brown to dark grayish brown, in hue from 7.5YR to 10YR, and in texture from loam to fine sandy loam. Its thickness ranges from 5 to 9 inches. Generally, the surface soil is strongly calcareous, but in a few places it is noncalcareous.

The AC horizon ranges in color from reddish brown to grayish brown, in hue from 5YR to 10YR, and in texture from loam to clay loam or sandy clay loam. The thickness ranges from 6 to 14 inches. This horizon is strongly calcareous to very strongly calcareous.

Depth to the Cca horizon ranges from 11 to 23 inches. Segregated concretions and soft lumps of disseminated calcium carbonate make up 30 to 60 percent of the soil mass.

MILES SERIES

The Miles series consists of deep, well-drained, brown to reddish-brown soils of the upland. Most areas are on high subrounded knolls and interridges throughout the southern and eastern parts of the county, but some are on a fairly large, gently rolling plain. Miles soils belong to the Reddish Chestnut great soil group. They formed from moderately sandy water-laid deposits, or plains outwash, of the Quaternary era. The loamy fine sands formed under tall grasses, but the fine sandy loams formed under mid grasses.

The Miles soils are not so dark as the Abilene soils and are sandier throughout their profile. Their surface layer is not so sandy as that of the Brownfield soils. Miles soils are similar to the Amarillo soils of the High Plains.

Typical profile of Miles fine sandy loam in a cultivated field (3.0 miles east of Kalgary and 1.4 miles northeast along a ranch road):

Ap—0 to 6 inches, reddish-brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak, granular structure; hard when dry, very friable when moist; noncalcareous; pH 7.2; abrupt boundary.

B21t—6 to 16 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; compound weak, very coarse, prismatic and moderate, medium, subangular blocky structure; very hard when dry, friable when moist; noncalcareous; pH 7.2; many, very fine pores; common worm casts; faint, patchy clay films; clear boundary.

B22t—16 to 34 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; compound weak, very coarse, prismatic and moderate, medium, subangular blocky structure; very hard when dry, friable when moist; noncalcareous; pH 7.2; many, very fine and fine pores; common worm casts; faint, patchy clay films; clear boundary.

B3—34 to 46 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; compound weak, very coarse, prismatic and moderate, medium, subangular blocky structure; hard when dry, friable when moist; strongly calcareous; pH 7.2; common threads and films of calcium carbonate between peds; a few soft lumps of segregated calcium carbonate; gradual boundary.

Cca—46 to 58 inches, pink (5YR 8/4) sandy clay loam, light reddish brown (5YR 6/4) moist; friable when moist; very strongly calcareous; about 40 percent of the soil mass consists of many, soft and hard, segregated lumps and concretions of calcium carbonate; gradual boundary.

C—58 to 64 inches +, pink (7.5YR 7/4) fine sandy loam; very friable when moist; strongly calcareous; common, very fine concretions of calcium carbonate.

The A horizon ranges in color from brown to reddish brown, in hue from 5YR to 7.5YR, and in texture from fine sandy loam to loamy fine sand. Its thickness ranges from 4 to 10 inches in the fine sandy loams, but in the loamy fine sands it ranges from 10 to 18 inches.

The B horizon ranges in color from red to yellowish red, in hue from 2.5YR to 5YR, and in texture from light sandy clay loam to loam. Its thickness ranges from 20 to 58 inches. The structure ranges from weak, coarse, prismatic to weak and moderate, fine to medium, subangular blocky. In about 40 percent of the areas, there is a B1 horizon. In some areas the B3 horizon is lacking.

Depth to the Cca horizon ranges from 30 to 52 inches, but in some areas this horizon is lacking. The texture ranges from loam to sandy clay loam. Segregated and disseminated concretions and soft lumps of calcium carbonate make up from 30 to 60 percent of the soil mass. Depth to the C horizon ranges from 24 to 76 inches.

OLTON SERIES

The Olton series consists of deep, dark-brown, well-drained soils of the upland that have a subsoil of blocky clay loam. These soils are in large areas in a smooth plain throughout the west-central part of the county. They belong to the Reddish Chestnut great soil group. Olton soils formed under short grasses from moderately fine textured, calcareous, wind-laid deposits.

These soils have a more clayey and blocky B horizon than the Amarillo soils. They are redder than the Pullman and Lofton soils and have a less clayey and blocky subsoil.

Typical profile of Olton loam in a field (2.2 miles south on Farm Road 378 from intersection of U.S. Highway No. 82 and Farm Road 378, and 50 feet east):

Ap—0 to 8 inches, dark-brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak, granular structure; hard when dry, friable when moist; noncalcareous; abrupt boundary.

B21t—8 to 15 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate, fine, subangular blocky structure; very hard when dry, firm when moist; a few very fine pores; noncalcareous; clear boundary.

B22t—15 to 28 inches, reddish-brown (5YR 4/3) heavy clay loam, dark reddish brown (5YR 3/3) moist; moderate, fine, blocky structure; very hard when dry, firm when moist; a few very fine and fine pores; noncalcareous; clear boundary.

B3—28 to 42 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; weakly calcareous; clear boundary.

Cca—42 to 54 inches, pink (7.5YR 8/4) clay loam, pink (7.5YR 7/4) moist; structureless; hard when dry, friable when moist; very strongly calcareous; calcium carbonate makes up 40 to 50 percent of the soil mass, by volume.

C—54 to 65 inches +, pink (5YR 8/4) clay loam, light reddish brown (5YR 6/4) moist; very strongly calcareous; a few soft lumps of calcium carbonate.

The A horizon ranges in color from reddish brown to dark brown, in hue from 5YR to 10YR, and in thickness from 6 to 9 inches. This horizon ranges from neutral to mildly alkaline.

The B horizon ranges in thickness from 24 to 44 inches and in texture from clay loam to light clay. Its structure ranges from weak to moderate, fine to medium, subangular blocky and blocky. The color ranges from reddish brown to yellowish red and the hue from 5YR to 7.5YR. Depth to the Cca horizon ranges from 30 to 53 inches.

PORTALES SERIES

The Portales series consists of deep, calcareous, friable soils of the upland. These soils are nearly level to gently sloping and occupy depressions surrounding playas. They are in the Calcisol great soil group. Portales soils formed in highly calcareous material deposited by wind and water, probably in the Pliocene or Pleistocene age. The native vegetation was mid and short grasses.

Unlike the Zita soils, the Portales soils are calcareous in the surface layer. They are darker and less limy than the Drake soils and have a thicker solum than the Mansker soils.

Typical profile of Portales loam in a cultivated field (1.6 miles west of Savage, 1.0 mile south, and 300 feet west):

Ap—0 to 14 inches, dark grayish-brown (10YR 4/2) heavy loam, very dark grayish brown (10YR 3/2) moist; weak, granular structure; hard when dry, very friable when moist; weakly calcareous; clear boundary.

AC—14 to 30 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; compound weak, coarse, prismatic and moderate, medium, subangular blocky structure; very hard when dry, friable when moist; strongly calcareous; a few hard concretions and soft lumps of calcium carbonate; a few worm casts; gradual boundary.

Cca—30 to 50 inches, very pale brown (10YR 8/4) heavy loam, very pale brown (10YR 7/4) moist; structureless; very hard when dry, friable when moist; very strongly calcareous; many soft lumps and concretions of calcium carbonate make up about 40 percent of the soil mass, by volume; gradual boundary.

C—50 to 60 inches +, reddish-yellow (7.5YR 8/5) clay loam, reddish yellow (7.5YR 7/5) moist; structureless; very hard when dry, firm when moist; a few hard and soft lumps of calcium carbonate.

The A horizon ranges in color from brown to dark grayish brown, in hue from 7.5YR to 10YR, in texture from loam to fine sandy loam, and in thickness from 7 to 22 inches. It ranges from weakly calcareous to strongly calcareous.

The AC horizon ranges in color from yellowish red to dark grayish brown, in hue from 5YR to 10YR, and in thickness from 12 to 25 inches. Its structure ranges from prismatic to moderate, medium to fine, subangular blocky.

This horizon ranges from strongly calcareous to very strongly calcareous.

Depth to the Cca horizon ranges from 19 to 47 inches. Between 30 and 60 percent of the soil mass of this horizon, by volume, consists of calcium carbonate.

POTTER SERIES

The Potter series consists of very shallow, strongly calcareous, gently sloping to steep soils that are in the Lithosol great soil group. These soils are mostly below the steep escarpment of the High Plains. They formed under short and mid grasses in a mixture of loamy earth and caliche, probably of the Pliocene era.

These soils are somewhat similar to the Mansker soils, but they have a thinner solum and are lighter colored than those soils.

Typical profile of Potter clay loam in a pasture (2.9 miles east of Crosbyton on U.S. Highway No. 82 from intersection of Farm Road 651, and 100 feet south):

A1—0 to 8 inches, brown (7.5YR 5/3) clay loam, dark brown (7.5YR 4/3) moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; many worm casts and root channels; a few hard concretions of calcium carbonate; strongly calcareous; abrubt, irregular boundary.

R—8 to 12 inches +, reddish-yellow (5YR 6/6) weakly cemented caliche; very strongly calcareous.

The A horizon ranges in thickness from 4 to 10 inches, in color from reddish brown to dark grayish brown, in hue from 5YR to 10YR, and in texture from fine sandy loam to loam or clay loam. In some areas this horizon contains as much as 50 percent caliche gravel. In places there is a thin Cca horizon. Depth to the R horizon ranges from 4 to 12 inches.

PULLMAN SERIES

The Pullman series consists of deep, dark, nearly level, fine-textured soils of the upland. These soils are in broad areas in the northern and northeastern parts of the county. They belong to the Chestnut great soil group. Pullman soils formed under short grasses from silty and clayey sediments, probably laid down by wind.

The Pullman soils have a more clayey B horizon than the Olton soils, but they are less red than those soils. They are similar to the Lofton soils but are not so dark in the subsoil.

Typical profile of Pullman silty clay loam in a cultivated field (1.0 mile south of Wake, then 0.5 mile west, 0.5 mile south, 3.0 miles west, 0.5 mile south, and 50 feet east):

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, granular structure; hard when dry, friable when moist; noncalcareous; abrupt boundary.

B21t—7 to 18 inches, dark-brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate, medium and fine, blocky structure; extremely hard when dry, firm when moist; a few very fine pores; distinct, patchy clay films; noncalcareous; gradual boundary.

B22t—18 to 24 inches, dark-brown (7.5YR 4/3) clay, dark brown (7.5YR 3/3) moist; moderate, medium and fine, blocky structure; extremely hard when dry, firm when moist; a few very fine pores; distinct, nearly continuous clay films; noncalcareous; gradual boundary.

B3—24 to 41 inches, brown (7.5YR 5/3) clay, dark brown (7.5YR 4/3) moist; moderate, medium and fine, blocky structure; very hard when dry, firm when moist; strongly calcareous; clear boundary.

Cca—41 to 52 inches, pink (7.5YR 8/4) clay loam, light brown (7.5YR 6/4) moist; structureless; slightly hard when dry, friable when moist; very strongly calcareous; 30 to 40 percent of this horizon is segregated calcium carbonate; diffuse boundary.

C—52 to 60 inches +, reddish-yellow (7.5YR 7/6) clay loam, reddish yellow (7.5YR 6/6) moist; structureless; slightly hard when dry, friable when moist; very strongly calcareous; many fine and medium concretions of calcium carbonate that decrease in number with increasing depth.

The A horizon ranges in color from brown to dark grayish brown, in hue from 7.5YR to 10YR, and in thickness from 5 to 9 inches. The B horizon ranges in color from reddish brown to dark brown, in hue from 5YR to 10YR, and in thickness from 22 to 38 inches. Its structure ranges from moderate to strong, medium and fine, blocky. This horizon ranges from noncalcareous to weakly calcareous. Depth to the Cca horizon ranges from 17 to 47 inches. The texture of this horizon ranges from clay loam to silty clay or clay.

RANDALL SERIES

The Randall series consists of gray and dark-gray, clayey soils. These soils are on the floors of playa basins and are ponded for extended periods after a heavy rain. They are in the Grumusol great soil group. Randall soils formed in clayey sediments derived from wind-laid or water-laid material, probably of the Pleistocene epoch.

The Randall soils have a more clayey surface layer than the Lofton soils.

Typical profile of Randall clay in a pasture (3.0 miles west of Farm Road 651 on Farm Road 40, 0.1 mile south on a rural road, and 1,100 feet east):

A1—0 to 25 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; weak, fine, blocky structure; very firm when moist, sticky and plastic when wet; weakly calcareous; gradual boundary.

AC—25 to 52 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; structureless and massive; very firm when dry, sticky and plastic when wet; strongly calcareous.

C—52 to 60 inches +, gray (10YR 6/1) clay, gray (10YR 5/1) moist; structureless and massive; strongly calcareous.

These soils range from noncalcareous in the uppermost 40 inches to very strongly calcareous throughout. The surface layer is fine sandy loam or is clay. The A horizon ranges in color from gray to dark grayish brown, in hue from 10YR to 2.5Y, and in thickness from 5 to 30 inches. Its structure ranges from weak to moderate blocky in the clay soils to granular and subangular blocky in the fine sandy loams.

The AC horizon ranges in color from dark gray to light gray, hue 10YR. Its structure ranges from blocky to massive. The thickness ranges from 10 to 30 inches.

Depth to the C horizon ranges from 15 to 60 inches. A few brown iron concretions occur in some areas below a depth of 30 inches. Also, in places this horizon has faint to distinct mottles of olive or pale yellow. In a few areas an indurated limestone layer is at a depth of 60 to 80 inches. This layer probably consists of Cretaceous material.

SPUR SERIES

The Spur series consists of deep, dark, well-drained, nearly level, calcareous soils of the bottom land. The soils belong to the Alluvial great soil group. They are in the southern and eastern parts of the county along the White and Brazos Rivers and along smaller streams. Spur soils

formed in calcareous, loamy alluvium. The native vegetation was short and mid grasses.

The Spur soils are darker to a greater depth than are the Berthoud and Bippus soils. Also, they formed in more recent sediment.

Typical profile of Spur clay loam in a pasture (4.0 miles north on Farm Road 651 from intersection of Farm Road 261, and 0.5 mile east):

A1—0 to 12 inches, dark-brown (7.5YR 4/3) clay loam, dark brown (7.5YR 3/3) moist; compound weak, coarse, prismatic and weak, granular structure; hard when dry, friable when moist; weakly calcareous; pH 7.8; many very fine to medium pores; common worm casts and roots; gradual boundary.

AC—12 to 34 inches, dark-brown (7.5YR 4/3) loam, dark brown (7.5YR 3/2) moist; weak, coarse, prismatic structure; strongly calcareous; pH 7.8; many very fine to medium pores; many worm casts; thin strata of fine sandy loam and clay loam; gradual boundary.

C—34 to 62 inches +, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 3/4) moist; weak, medium, subangular blocky structure; hard when dry; strongly calcareous; pH 7.8.

The A horizon ranges in color from brown to dark grayish brown and in hue from 7.5YR to 10YR. It ranges from 5 to 26 inches in thickness and from fine sandy loam to clay loam in texture. The AC horizon ranges in color from brown to dark grayish brown and in hue from 7.5YR to 10YR. It ranges from loam to clay loam or silty clay loam in texture and from 14 to 28 inches in thickness. This horizon ranges from strongly calcareous to very strongly calcareous. In places an AC horizon of reddish-brown fine sandy loam is present. The C horizon ranges in texture from very fine sandy loam to loam or clay loam, and in depth from 22 to 48 inches.

STAMFORD SERIES

The Stamford series consists of reddish, moderately deep, gently sloping, calcareous soils of the upland. These soils belong to the Regosol great soil group. They are generally adjacent to small drainageways and below steep ridges in the eastern part of the county. Stamford soils formed under short grasses in calcareous clay from red beds of the Permian period.

The Stamford soils have a thicker solum than the Vernon soils. They are more clayey throughout than the Abilene soils, and unlike those soils, they are calcareous in the surface layer.

Typical profile of Stamford clay (about 14.0 miles south-southeast of Crosbyton on a large ranch):

Ap—0 to 7 inches, brown (7.5YR 5/4) clay, brown (7.5YR 4/4) moist; moderate, medium and fine, blocky structure; extremely hard when dry, extremely firm when moist; strongly calcareous; a few, fine, hard concretions of calcium carbonate; common roots between peds; gradual boundary.

AC—7 to 38 inches, strong-brown (7.5YR 5/6) clay, strong brown (7.5YR 4/6) moist; moderate, medium, blocky structure; extremely hard when dry, extremely firm when moist; very strongly calcareous; a few, hard, fine concretions of calcium carbonate; gradual boundary.

C—38 to 48 inches +, reddish-brown (5YR 4/5) partly weathered red-bed clay; very strongly calcareous.

The A horizon ranges in color from reddish brown to brown, in hue from 5YR to 7.5YR, and in thickness from 5 to 12 inches. Its texture ranges from clay loam to clay. This horizon ranges from weakly calcareous to strongly calcareous. The AC horizon ranges in color from reddish brown to strong brown, in hue from 2.5YR to 7.5YR and in thickness from 25 to 40 inches. The structure is moderate, fine to medium, blocky. This horizon ranges from very strongly calcareous to strongly calcareous. Depth to the C horizon ranges from 30 to 52 inches.

TIVOLI SERIES

The Tivoli series consists of light-colored sandy soils of the upland that belong to the Regosol great soil group. These soils are in dunes adjacent to the White and Brazos Rivers, mostly in the southern part of the county. They formed under tall grasses in material derived from eolian sands of the Quaternary period.

Tivoli soils are sandier throughout the profile than the Brownfield, Likes, Miles, and Amarillo soils.

Typical profile of Tivoli fine sand in a pasture (0.1 mile east of the White River bridge on Farm Road 261, 0.1 mile south of a rural road, and 50 feet west):

A1—0 to 10 inches, brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; structureless (single grain); loose when dry and moist; weakly calcareous; the uppermost 4 inches is darker and more loamy than the rest of this horizon; gradual boundary.

C—10 to 60 inches +, light yellowish-brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) moist; structureless (single grain); loose when dry and moist; weakly calcareous.

The A horizon ranges in thickness from 6 to 10 inches. It also ranges from noncalcareous to strongly calcareous.

TRAVESSILLA SERIES

The Travessilla series consists of very shallow, calcareous, gently sloping to moderately steep soils. These soils are in the Lithosol great soil group. They formed under short to mid grasses from sandstone, probably of the Triassic period. In this county they are mapped only as a complex with the Vernon soils.

The Travessilla soils are sandier than the Vernon soils. They contain less calcium carbonate than the Potter soils.

Typical profile of Travessilla fine sandy loam in a pasture (2.3 miles east of Farm Road 651 on the White River Dam Road and 0.2 mile north):

A1—0 to 3 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, granular structure; hard when dry, friable when moist; weakly calcareous; many siliceous pebbles on the surface; abrupt boundary.

R—3 to 4 inches +, light-gray (10YR 7/2) indurated sandstone.

The A horizon ranges in color from reddish brown to grayish brown, in hue from 5YR to 10YR, and in thickness from 2 to 5 inches. This horizon contains as much as 50 percent siliceous gravel and stones in places. In some places it is noncalcareous.

VERNON SERIES

The Vernon series consists of reddish, shallow soils that are in the Lithosol great soil group. These soils are widely scattered throughout the southern part of the county. They formed under short grasses in clay from red beds, mainly of the Permian period.

The Vernon soils have a thinner solum than the Stamford soils.

Typical profile of Vernon clay loam in a range (6.0 miles north on Farm Road 651 from intersection of Farm Road 261, about 3.0 miles east, and 0.3 mile south):

A1—0 to 6 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; strongly calcareous; pH 7.5; a few roots and quartz pebbles; clear boundary.

AC—6 to 14 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate, fine blocky structure; very hard when dry, very firm when moist; strongly calcareous; pH 7.5; a few roots between peds; a few soft spots of calcium carbonate; clear boundary.

C—14 to 20 inches +, reddish-brown (2.5YR 4/4), partly weathered, strongly calcareous, red-bed clay.

The A horizon ranges in color from light red to light brown, and in hue from 5YR to 7.5YR. It ranges in thickness from 6 to 8 inches and in texture from clay to clay loam. The AC horizon ranges in color from red to reddish brown, in hue from 2.5YR to 5YR, and in thickness from 0 to 14 inches.

ZITA SERIES

The Zita series consists of deep, dark, well-drained, nearly level to gently sloping, friable soils of the upland. These soils belong to the Chestnut great soil group. They are mostly in the western part of the county in areas that have a slightly lower elevation than the surrounding soils of the upland. Zita soils formed under short and mid grasses from limy plains sediment of the late Pleistocene period.

These soils differ from the Portales soils in being noncalcareous in the A horizon. They lack the blocky B horizon of the Pullman, Lofton, and Olton soils and are less clayey than those soils. They are darker than the Amarillo soils.

Typical profile of Zita loam in a cultivated field (1.0 mile west and 1.5 miles south of Owens, Tex., and 0.4 mile west):

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak, granular structure; hard when dry, friable when moist; noncalcareous; abrupt boundary.

A1—7 to 18 inches, very dark grayish-brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; compound weak, coarse, prismatic and granular structure; hard when dry, friable when moist; many fine to medium pores and worm casts; noncalcareous; clear boundary.

AC—18 to 32 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; compound weak, coarse, prismatic and weak, granular structure; very hard when dry, friable when moist; many fine pores; common worm casts; strongly calcareous; clear boundary.

Cca—32 to 48 inches, very pale brown (10YR 8/3) clay loam, very pale brown (10YR 7/3) moist; calcium carbonate equivalent makes up 40 to 50 percent of the volume; very strongly calcareous; diffuse boundary.

C—48 to 60 inches +, very pale brown (10YR 8/3) clay loam, very pale brown (10YR 7/3) moist; calcium carbonate equivalent makes up 15 to 20 percent of the volume; 15 to 20 percent consists of soft and hard, fine concretions; very strongly calcareous.

The A horizon ranges in color from brown to very dark grayish brown and in hue from 7.5YR to 10YR. Its thickness ranges from 8 to 22 inches and its texture from loam to fine sandy loam. The structure ranges from weak to moderate, prismatic and granular. The AC horizon ranges in color from pale brown to dark grayish brown, and in hue from 7.5YR to 10YR. The structure ranges from weak, coarse, prismatic to weak, subangular blocky to granular, and thickness from 6 to 30 inches. Depth to the Cca horizon ranges from 14 to 52 inches. In this horizon the amount of calcium carbonate ranges from 30 to 60 percent of the volume. The C horizon ranges in color from light gray to grayish brown or pale brown, hue 10YR.

General Nature of the County

In this section some general characteristics of the county are discussed. These include geology, climate, and agriculture.

Geology

A knowledge of the geology of Crosby County is helpful in understanding the soils. Therefore, a brief geologic history of the county is given in the paragraphs that follow.

At the beginning of Permian time, about 200 million years ago, this part of Texas was covered by a shallow sea. By this time mountains from earlier geologic time had been folded and had subsided to form basins that were separated in places by uplifted areas. Sediments that ranged from marine to continental, or nonmarine, in origin were deposited during Permian time and filled the basins. These sediments include salt, anhydrite, gypsum, and other chemical precipitates deposited early in Permian time. Evaporites and nonmarine sediments deposited later in Permian time indicate that the sea withdrew intermittently but progressively. The sediments laid down in Permian time form the red beds that underlie all of the High Plains. Soils of the Vernon series are those that formed in material from red beds.

Geologic erosion apparently took place in the High Plains part of the county in Early and Middle Triassic time. The resulting sediments were laid down by wind in Late Triassic time in lakes and streams of the area. They comprise a series of formations known as the Dockum group.

In Early Cretaceous time the sea, for the last time, advanced across the High Plains. It came from the southeast and deposited the sediments that form the rock of the Comanche series and then withdrew.

During Late Cretaceous time and early in the Cenozoic era, extensive geologic erosion took place and removed all of the Cretaceous rock and part of the Triassic rock. Also, during much of this time, as a result of mountain making, uplift, and volcanic activity in New Mexico and Colorado, the Southern Rocky Mountains and mountain ranges to the south of them in New Mexico and Texas developed. Sediments derived largely from the rising mountains to the west and northwest were laid down in the High Plains by wind during the Cenozoic era. The building of the High Plains came to a climax during this era, and erosion and physiographic isolation of the area began.

The High Plains probably were being eroded all during Tertiary time and until the Pliocene epoch. Then streams flowing eastward from the recently uplifted mountains deposited sand and gravel on the surfaces of eroded, older

rocks. The Ogallala formation developed from these deposits. The source of the underground water in Crosby County is not an underground river or lake, but the saturated beds of sand and gravel in the lower part of the Ogallala formation. At present rain or snow that falls on the High Plains is the only source of water to replenish the underground supply.

Stream deposition ceased when the plains surface had been built up to about its present level, probably toward the end of middle Pliocene time. The surface of the alluvial plain remained in a state of near equilibrium, probably through late Pliocene time. Caprock caliche, which is conspicuously exposed along the plains escarpment, probably began to form at or near the surface during this period. The Potter soils were formed from areas of caliche.

In the High Plains during the Quaternary period, cycles of erosion and deposition of sediments by streams occurred. Deep reentrant canyons formed in this county during Pleistocene time. They apparently were cut mainly during intervals of accelerated erosion that were interrupted by long periods of relative stability.

The surface of the plains was modified during the Quaternary period by the widespread deposition of eolian sand, by the accumulation of sediments in basins, and by alternate periods of erosion and deposition along the stream valleys. The valleys were probably shallow in most of the High Plains area. They became deeper as they approached the deep canyons along and below the escarpment. Soils formed from such sediments are those of the Abilene, Miles, and similar series.

In the High Plains in this part of the State are extensive areas of reddish sand that contain varying amounts of silt and clay (*4*). These materials were probably laid down during Pleistocene time and are the parent materials of the Amarillo, Olton, and similar soils. The profile of these soils is strongly developed in the upper part. It is more than 25 feet thick in places, but the average thickness is less than 10 feet.

Climate [4]

Crosby County has a subhumid climate. The county lies in an area that is transitional between the more desertlike region of eastern New Mexico and the more humid region of central and east Texas. The temperature and precipitation for the county, as recorded at the U.S. Weather Bureau Station at Crosbyton, Tex., is given in table 8.

Rains occur most frequently in thunderstorms, and the amounts of monthly and annual rainfall vary greatly. The maximum rainfall is generally during May, June, and July when warm, moist air from the Gulf of Mexico is carried inland. This air mass causes moderate to heavy thunderstorms in the afternoon and evening, and the storms are sometimes accompanied by hail. In all months except May and July, there are periods of 2 to 3 weeks when no measurable rain occurs. Records show that in 1 year in 10 any of the winter months (November through March) are likely to have less than 0.01 inch of rain. Annual extremes range from 7.62 inches in 1956 to 44.42 inches in 1941. Much of the precipitation that falls during exceptionally wet years has little benefit on crops, as it falls during heavy thunderstorms, and runoff is excessive.

Snow falls occasionally during the winter months but is generally light and remains on the ground only a short

[4] By ROBERT B. ORTON, State climatologist, Weather Bureau, U.S. Department of Commerce.

TABLE 8.—*Temperature and precipitation*

[Elevation

Month	Temperature											
	Average				Extremes				Average number of days when maximum temperature is—		Average number of days when minimum temperature is—	
	Daily maximum	Daily minimum	Monthly	Degree days	Highest recorded		Lowest recorded		90° or above	32° or below	32° or below	0° or below
	°F.	*°F.*	*°F.*	*Number*	*°F.*	*Year*	*°F.*	*Year*	*Days*	*Days*	*Days*	*Days*
January	53.8	25.3	39.6	828	81	1950	−6	1947	0	2	25	(2)
February	57.2	27.9	42.6	675	86	1940	−6	1951	0	2	20	(2)
March	65.4	33.6	49.5	521	93	1940	0	1948	(2)	1	15	0
April	75.5	43.7	59.6	223	101	1959	20	[4] 1945	4	(2)	3	0
May	82.4	53.9	68.2	49	106	1938	32	[4] 1960	8	0	(2)	0
June	91.7	63.5	77.6	7	110	1934	40	1946	20	0	0	0
July	94.1	66.3	80.2	(2)	109	[4] 1944	54	1952	23	0	0	0
August	94.0	65.4	79.7	0	110	1936	52	[4] 1961	25	0	0	0
September	85.8	58.0	71.9	14	108	1948	36	1935	14	0	0	0
October	75.8	47.3	61.6	175	96	1951	24	1957	2	0	1	0
November	62.6	33.3	48.0	546	89	1934	4	1957	0	0	14	0
December	56.1	27.6	41.9	721	84	1937	3	1950	0	1	26	0
Year	74.5	45.5	60.0	3,759	110	[4] 1936	−6	[4] 1951	--------	--------	--------	--------

[1] Most of the averages and extremes of temperature and precipitation are for the 30-year period, 1932–61. Average number of degree days, however, is for a 7-year period. Average number of days for extremes of temperature and precipitation is for a 10-year period, except for data in the column entitled "Average number of days when precipitation is 0.10 inch or more," which is for an 8-year period. Average length of record is 66 years.

time. The mean monthly snowfall data are influenced by rare, but exceptionally heavy snows. In April of 1942, for example, 14.0 inches of snow fell at Crosbyton, although the chances that no measurable snow will fall during this month are almost 9 to 1.

Temperatures, like rainfall, vary greatly, especially during the colder 6 months of the year. From November through March, frequent surges of cold air from the north bring rapid and pronounced changes. Cold spells are rather short, however, and rarely last more than 48 hours before winds from the west and southwest bring rapid warming. Strong, fast-moving cold fronts that follow several weeks of mild weather late in spring sometimes damage plants. This possibility of late freezes discourages the growing of fruit trees any place in the county. Summer days are hot, but the low humidity and good wind circulation modify the effects of the heat. Most summer nights are pleasantly cool because of rapid radiation after sundown. The highest temperature recorded in Crosbyton was 110 degrees in June 1934, and again in August 1936.

Freeze data have been estimated for Crosby County. April 10 is the average date of the last freezing temperature in spring, and November 2 is the average date of the first freezing temperature in fall. March 30 is the average date of the last occurrence of 28° temperature in spring, and November 13 is the average date of the first occurrence of this temperature in fall.

The average frost-free period is about 206 days. This period covers the number of days between the average last occurrence of 32° F. temperature in spring and the average first occurrence in fall. The average number of days between the last occurrence of 28° F. temperature in spring and the first occurrence in fall is 228 days.

The chances are that 1 year in 5 a 32° freeze will occur in spring after April 21, and 1 year in 20, after May 2. The chances are that a 32° freeze will occur in fall 1 year in 5 before October 25, and 1 year in 20, before October 19.

Winds are strongest during intense thunderstorms, but these are of short duration. The strongest continuous winds occur during February, March, and April. The prevailing winds are from the southwest and often cause severe duststorms early in spring. The caprock, or edge of the Llano Estacado, lies across the southeastern part of the county. It has a distinct influence on the weather when the wind blows from the east or southeast, especially in winter. Low clouds and drizzle increase along the caprock in cold air masses when the wind blows from either of these directions. In the area below the caprock, the temperatures in winter and in summer are slightly warmer than in other parts of the county.

Relative humidity is highest during the early morning hours, and readings average about 75 percent at 6:00 a.m. The lowest relative humidity is during the heat of early afternoon. The average relative humidity is about 42 percent at 6:00 p.m. The highest average relative humidity is in October, and the lowest is in April.

Severe winds or hailstorms sometimes accompany heavy thunderstorms, particularly late in spring and early in summer. Crops may be damaged by wind or hail, or by the excessive rain that accompanies these storms. Fortunately, the frequency of severe storms for a single farm, city, or similar small area, is relatively low. During the 66-year period from 1896 through 1961, only 6 tornadoes occurred in Crosby County.

Sunshine is abundant the year round. The infrequent cloudy weather occurs mostly during winter and early in spring.

at Crosbyton, Tex., 1932–61 [1]

3,105 feet]

Precipitation												
Average monthly	Greatest daily		Driest year (1956)	Wettest year (1941)	Precipitation to be expected 1 year in 10		Average number of days when precipitation is—			Snow, sleet		
					Less than	More than	0.10 inch or more	0.50 inch or more	1.00 inch or more	Average	Most	
	Inches	*Year*	*Inches*	*Inches*	*Inches*	*Inches*	*Days*	*Days*	*Days*	*Inches*	*Inches*	*Year*
0. 92	2. 00	1939	0. 05	1. 55	0. 01	1. 70	2	(2)	0	2. 4	9. 6	1949
. 78	1. 68	1961	. 96	1. 29	. 01	2. 05	2	(2)	(2)	2. 7	16. 0	1961
. 74	1. 20	1941	(3)	3. 07	. 01	2. 14	3	(2)	0	1. 1	9. 0	1958
1. 54	2. 80	1942	. 51	3. 50	. 15	4. 18	3	1	1	. 6	14. 0	1942
3. 44	3. 74	1954	2. 48	9. 33	. 41	5. 99	6	2	1	. 0	. 0	--------
2. 64	2. 18	1959	1. 46	4. 97	. 32	5. 82	6	2	1	. 0	. 0	--------
2. 66	3. 00	1938	. 80	2. 77	. 30	6. 20	5	3	1	. 0	. 0	--------
2. 10	3. 62	1933	. 23	2. 49	. 07	5. 10	2	(2)	(2)	. 0	. 0	--------
2. 23	4. 85	1942	. 17	4. 55	. 17	5. 90	2	1	(2)	. 0	. 0	--------
2. 62	3. 56	1953	. 54	9. 50	. 15	6. 43	3	2	1	(3)	(3)	[4] 1957
. 83	1. 70	1961	. 06	. 26	. 01	2. 61	2	1	(2)	1. 0	10. 0	1957
. 92	2. 64	1932	. 36	1. 14	. 01	2. 33	2	1	(2)	2. 2	12. 0	1942
21. 42	4. 85	1942	7. 62	44. 42	12. 75	30. 56	38	13	5	10. 0	16. 0	1961

[2] Less than one-half day.
[3] Trace.
[4] Also on earlier dates, months, or years.

Evaporation is high. The average annual evaporation from Weather Bureau pans is approximately 102 inches. Of this amount, about 66 percent evaporates during the growing season from May through October. The average annual lake evaporation is 70 inches.

Agriculture

During the latter part of the 19th century, Crosby County was inhabited by Comanche Indians. They camped along the caprock escarpment to make use of the many fresh-water springs and controlled the plains until about 1870.

Millions of buffalo roamed the plains, but by 1877 buffalo hunters had slaughtered most of them. During this period a few ranchers began to settle in the area. The first ranch known to have been established was settled by Hank Smith in 1876. In the same year the area was designated a county by act of the 19th State Legislature. It was named for Stephen F. Crosby.

Crosbyton, the county seat, was started in 1908, and Ralls, Lorenzo, and other communities were started 3 years later. Also, in 1911, the first railroad, the Crosbyton-South Plains, was completed. According to the Federal census, in 1960 the population of the county was 10,347, and that of Crosbyton was 2,088.

The heavy growth of nutritious short and mid grasses made the county well suited to livestock. As a result, cattle raising was the first agricultural enterprise. The first land cultivated was about 20 acres near Estacado in 1879, but the first large acreage, about 10,000 acres, was cultivated in about 1910. This was the year the change from ranching to farming took place. At the time this soil survey was made, most of the rangeland was in the rolling country below the caprock.

Most of the cultivated land is used for cotton and sorghum. For example, in 1912 there were 1,037 bales of cotton ginned, and in 1909, 3,563 acres of sorghum planted. According to the U.S. Census of Agriculture, by 1959, there were 115,982 acres of cotton planted and 103,541 acres of grain sorghum planted. In the same year the number of farms in the county was 716.

Table 9 gives the acreage of principal crops grown in the county in stated years, as reported in the U.S. Census of Agriculture. The main crops are cotton, wheat, and sorghum.

TABLE 9.—*Acreage of principal crops in stated years*

Crop	1949	1954	1959
	Acres	*Acres*	*Acres*
Cotton harvested	166, 610	121, 820	114, 739
Sorghum for all purposes except sirup	51, 669	114, 716	103, 541
Corn for all purposes	353	905	1, 146
Small grains harvested:			
Wheat	60, 751	34, 090	28, 603
Oats	630	209	292
Barley	2, 106	2, 823	5, 404
Hay crops, total	370	1, 191	474
Vegetables harvested for sale	15	13	403

The raising of livestock provides a large part of the farm income in Crosby County. Most of this income is derived from the sale of grazing animals, mainly beef cattle. The number of cattle has fluctuated according to the demand, but since the census of 1954, the trend has been upward. Hogs and pigs and sheep and lambs are raised by the general farmers in the county. The numbers and kinds of livestock in the county in stated years are shown in table 10.

TABLE 10.—*Principal livestock on farms in stated years*

Livestock	1950	1954	1959
	Number	*Number*	*Number*
Cattle and calves	12, 491	10, 447	12, 371
Milk cows	2, 397	1, 258	596
Horses and mules	386	323	348
Hogs and pigs	6, 291	3, 779	5, 908
Sheep and lambs	550	698	1, 977
Chickens 4 months old and more	68, 276	40, 197	31, 171

Glossary

Aggregate, soil. Many fine particles held together in a single mass or cluster, such as a clod, crumb, block, or prism.

Alluvium. Soil material, such as gravel, sand, silt, or clay, deposited on land by streams.

Calcareous soil. A soil containing enough calcium carbonate to effervesce (fizz) when treated with dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors that consist of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent; will not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Drainage, natural. Refers to moisture conditions that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets.

Excessively drained soils are commonly very porous and are rapidly permeable and have a low water-holding capacity.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Imperfectly or somewhat poorly drained soils are wet for significant periods but not all the time, and in podzolic soils commonly have mottlings below 6 to 16 inches, in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Dune. A mound or ridge of loose sand piled up by the wind. In this county dunes generally have slopes of more than 8 percent and are less than 10 feet high.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Gravel. A soil separate, rounded or angular, having a diameter ranging from 2.0 millimeters to 80 millimeters. The content of gravel is not used in determining the textural class of the soil.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes (*11*). These are the major horizons:

A horizon.—The mineral horizon at the surface. It contains an accumulation of organic matter, has been leached of soluble minerals and clay, or shows the effects of both.

B horizon.—The horizon in which clay minerals or other material has accumulated, or that has developed a characteristic blocky or prismatic structure, or that shows the characteristics of both processes.

C horizon.—The unconsolidated material, excluding bedrock, that is immediately under the true soil.

R horizon.—The underlying consolidated bedrock.

Hummocky. Irregular and choppy topography marked by small dunes or mounds that are 3 to 10 feet high and have slopes that range from 3 to 8 percent.

Irrigation. Application of water to soils to assist in the production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and is distributed uniformly over the field.

Furrow.—Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Loam. Soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Morphology, soil. The makeup of the soil, including the texture, structure, consistence, color, and other physical, chemical, mineralogical, and biological properites of the various horizons that make up the soil profile.

Outwash. Cross-bedded gravel, sand, silt, and clay deposited by meltwater as it flowed from glacial ice; overwash. In this county outwash refers to soil material that was washed by meltwater from areas in the High Plains and Rocky Mountains, then carried by streams and deposited on the Permian red beds during the Pleistocene epoch.

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which the soil forms; horizon C in the soil profile.

pH. A numerical means used for designating relatively weak acidity and alkalinity, as in soils and other biological systems. A pH value of 7.0 indicates precise neutrality; higher values indicate increasing alkalinity, and lower values indicate increasing acidity. See also, *Reaction, soil.*

Phase, soil. A subdivision of a soil type, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects management.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Poorly graded soil. A soil consisting mainly of particles of nearly the same size. Because there is little difference in the size of the particles in poorly graded soil material, the density can be increased only slightly by compaction.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. The degrees of acidity or alkalinity are expressed in words as follows:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in soils having diameters that range from 0.05 millimeter to 2.0 millimeters. Sand grains consist chiefly of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). The soil in this textural class contains 80 percent or more silt and less than 12 percent clay.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The following separates are recognized by the International Society of Soil Science: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Soil slope. The incline of the surface of a soil. It is generally expressed as a percentage which equals the number of feet of fall per 100 feet of horizontal distance.

Solum. The upper part of a soil profile, above the parent material in which the processes of soil formation are active. In mature soil it includes the A and B horizons. The living roots and other plant and animal life characteristic of the soil are mainly confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer lying beneath the solum, or true soil; the C or D horizon.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour, or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Soil textural classes named in this report in classifying the soils of the county are *fine sand, loamy fine sand, sandy loam, fine sandy loam, very fine sandy loam, loam, silt loam, clay loam, silty clay loam,* and *clay.*

Topsoil. Fertile soil or soil material, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Type, soil. A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.

Undulating. A relief characterized by successive rolls, or rounded elevations, and depressions. In this county the rises are less than 5 feet high and have slopes of less than 3 percent.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Literature Cited

(1) American Association of State Highway Officials.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 pts., illus.

(2) Bennett, Hugh Hammond.
1939. SOIL CONSERVATION. 993 pp., illus.

(3) Chepil, W. S., Woodruff, N. P., and Zingg, A. W.
1955. FIELD STUDY OF WIND EROSION IN WESTERN TEXAS. U.S. Dept. Agr. SCS–TP–125, 59 pp., illus.

(4) Cronin, J. G.
1961. A SUMMARY OF THE OCCURRENCE AND DEVELOPMENT OF GROUND WATER IN THE SOUTHERN HIGH PLAINS OF TEXAS. Tex. Bd. of Water Engin. and U.S. Geol. Surv. Bul. 6107, 104 pp., illus.

(5) Frye, John C., and Leonard, A. Bryon.
1957. STUDIES OF CENOZOIC GEOLOGY ALONG EASTERN MARGIN OF TEXAS HIGH PLAINS, ARMSTRONG TO HOWARD COUNTIES. Univ. Tex., Bur. Econ. Geol. Rept. 32: 60 pp., illus.

(6) Harper, W. G.
1957. MORPHOLOGY AND GENESIS OF CALCISOLS. Soil Sci. Soc. Amer. Proc. 21: pp. 420–424.

(7) Oakes, Harvey and Thorp, James.
1950. DARK-CLAY SOILS OF WARM REGIONS VARIOUSLY CALLED RENDZINA BLACK COTTON SOILS, REGUR, AND TIRS, Soil Sci. Soc. Amer. Proc. 15: pp. 347–354, illus.

(8) Portland Cement Association.
1956. PCA SOIL PRIMER. 86 pp., illus. Chicago.

(9) Thorp, J., and Smith, Guy D.
1949. HIGHER CATEGORIES OF SOIL CLASSIFICATIONS; ORDER, SUBORDER, AND GREAT SOIL GROUPS. Soil Sci. 67: 117–126, illus.

(10) United States Department of Agriculture.
1938. SOILS AND MEN. U.S. Dept. Agr. Ybk., 1,232 pp., illus.

(11) ———
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handb. No. 18, 503 pp., illus.

(12) ———
1959. SOIL SURVEY, LYNN COUNTY, TEX. Series 1953, No. 3, 37 pp., illus.

(13) ———
1960. SOIL SURVEY, DAWSON COUNTY, TEX. Series 1957, No. 6, 58 pp., illus.

(14) ———
1962. SOIL SURVEY, LAMB COUNTY, TEX. Series 1959, No. 7, 68 pp., illus.

(15) ———
1962. SOIL SURVEY, TERRY COUNTY, TEX. Series 1959, No. 6, 57 pp., illus.

(16) Waterways Experiment Station, Corps of Engineers.
1953. THE UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. No. 3–357, 2 v. & appendix. (Revised 1957)

Accessibility Statement

The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The USDA Target Center can convert USDA information and documents into alternative formats, including Braille, large print, video description, diskette, and audiotape. For more information, visit the TARGET Center's Web site (http://www.targetcenter.dm.usda.gov/) or call (202) 720-2600 (Voice/TTY).

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

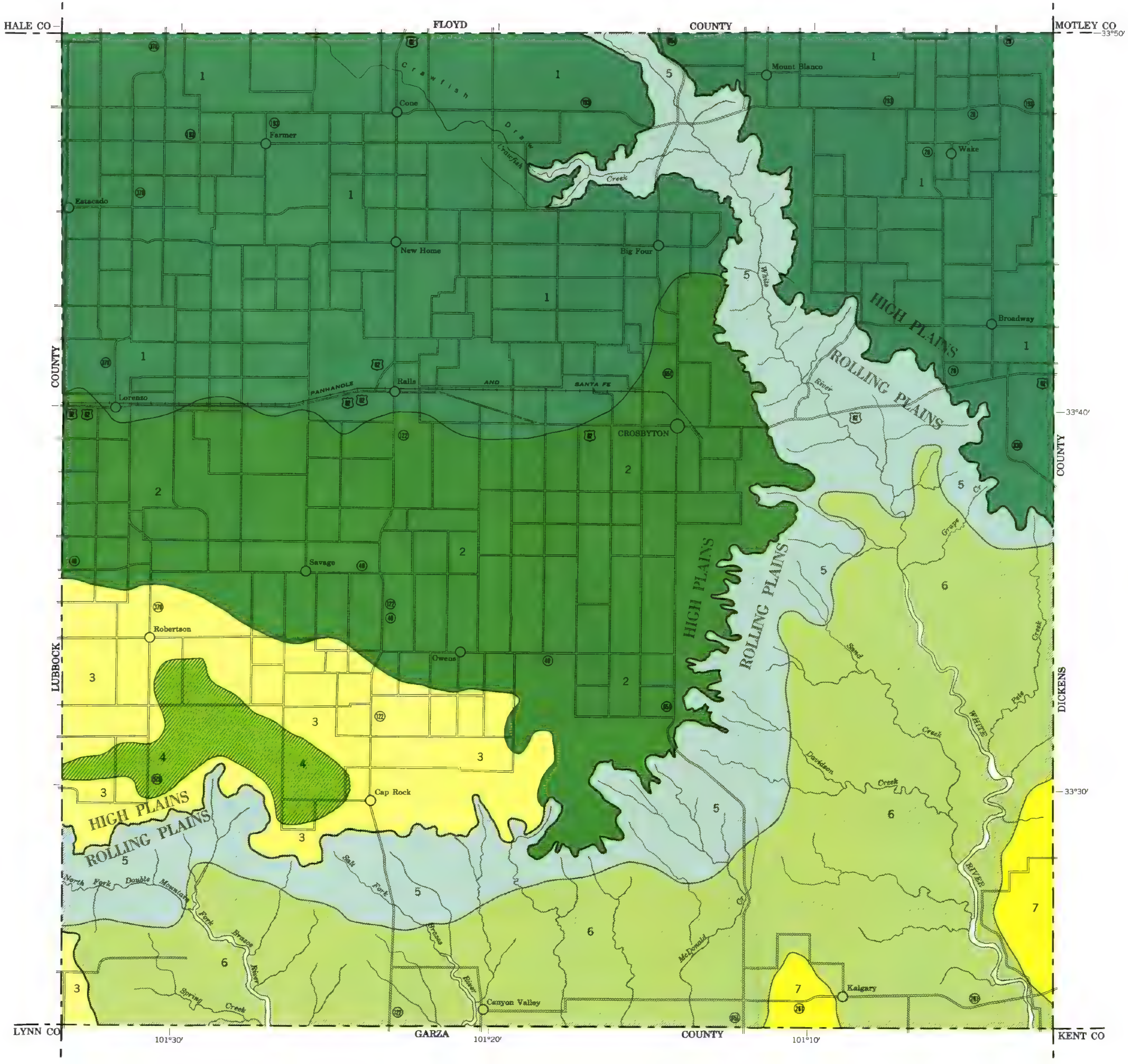
To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

N

GENERAL SOIL MAP
CROSBY COUNTY, TEXAS

SOIL ASSOCIATIONS

SOIL ASSOCIATIONS OF THE HIGH PLAINS

- 1 Pullman association: Deep hardland
- 2 Olton association: Mixed land
- 3 Amarillo association: Moderately sandy land
- 4 Amarillo-Brownfield association: Sandy land

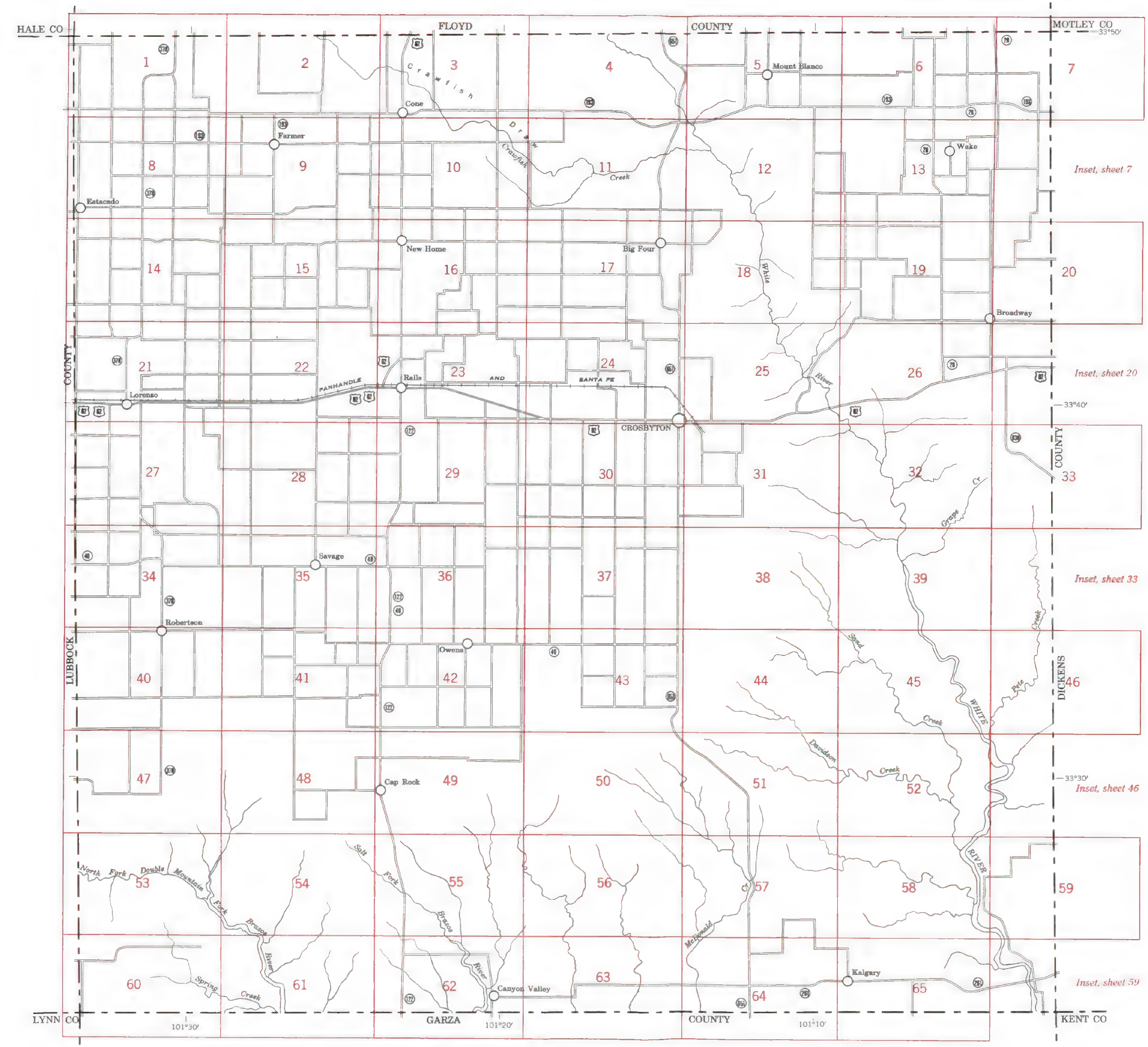
SOIL ASSOCIATIONS OF THE ROLLING PLAINS

- 5 Berthoud-Mansker-Potter association: Shallow land
- 6 Miles-Mansker association: Moderately sandy land
- 7 Brownfield-Miles association: Sandy land

December 1964

Scale 1:190080

1 0 1 2 3 4 Miles



N

INDEX TO MAP SHEETS
CROSBY COUNTY, TEXAS

Scale 1:190080

1 0 1 2 3 4 Miles

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, or D, shows the slope. Most symbols without a slope letter are those for nearly level soils such as Lofton clay loam, but some are for soils that have considerable range in slope, such as Potter soils. A final number, 3, in the symbol means that a soil is severely eroded. (W) following the soil name indicates that signs of erosion, especially of local shifting of soil by wind, are evident in places, but the degree of erosion cannot be estimated reliably.

SYMBOL	NAME
AbA	Abilene clay loam, 0 to 1 percent slopes
AbB	Abilene clay loam, 1 to 3 percent slopes
AfA	Amarillo fine sandy loam, 0 to 1 percent slopes
AfB	Amarillo fine sandy loam, 1 to 3 percent slopes
AmB	Amarillo loamy fine sand, 0 to 3 percent slopes (W)
Ba	Badland
BfB	Berthoud fine sandy loam, 1 to 3 percent slopes
BfC	Berthoud fine sandy loam, 3 to 5 percent slopes
BfD	Berthoud fine sandy loam, 5 to 8 percent slopes
BmC	Berthoud loam, 3 to 5 percent slopes
BmD	Berthoud loam, 5 to 8 percent slopes
Br	Brownfield fine sand (W)
Bs3	Brownfield soils, severely eroded
BtB	Bippus clay loam, 1 to 3 percent slopes
DrB	Drake clay loam, 1 to 3 percent slopes
DrC	Drake clay loam, 3 to 5 percent slopes
Hg	Hilly gravelly land
Lk	Likes loamy fine sand (W)
Lm	Loamy alluvial land
Ln	Lofton clay loam
Lp	Lofton fine sandy loam
MaA	Mansker fine sandy loam, 0 to 1 percent slopes
MaB	Mansker fine sandy loam, 1 to 3 percent slopes
MaC	Mansker fine sandy loam, 3 to 5 percent slopes
MkA	Mansker loam, 0 to 1 percent slopes
MkB	Mansker loam, 1 to 3 percent slopes
MkC	Mansker loam, 3 to 5 percent slopes
Mt	Mansker–Potter complex
MmB	Miles loamy fine sand, 0 to 3 percent slopes (W)
MmC	Miles loamy fine sand, 3 to 5 percent slopes (W)
MnA	Miles fine sandy loam, 0 to 1 percent slopes
MnB	Miles fine sandy loam, 1 to 3 percent slopes
MnC	Miles fine sandy loam, 3 to 5 percent slopes
OtA	Olton loam, 0 to 1 percent slopes
OtB	Olton loam, 1 to 3 percent slopes
PfA	Portales fine sandy loam, 0 to 1 percent slopes
PfB	Portales fine sandy loam, 1 to 3 percent slopes
PmA	Portales loam, 0 to 1 percent slopes
PmB	Portales loam, 1 to 3 percent slopes
Ps	Potter soils
PuA	Pullman silty clay loam, 0 to 1 percent slopes
PuB	Pullman silty clay loam, 1 to 3 percent slopes
Ra	Randall clay
Rf	Randall fine sandy loam
Rm	Rough broken land
Sa	Sandy alluvial land
Sc	Spur clay loam
Sf	Spur fine sandy loam
SmB	Stamford clay, 1 to 3 percent slopes
StA	Stamford soils, 0 to 1 percent slopes
Tv	Tivoli fine sand (W)
Vb	Vernon–Travessilla complex
VcB	Vernon clay loam, 1 to 3 percent slopes
VcD	Vernon clay loam, 3 to 15 percent slopes
ZfA	Zita fine sandy loam, 0 to 1 percent slopes
ZmA	Zita loam, 0 to 1 percent slopes
ZmB	Zita loam, 1 to 3 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries

Mine dump

Pits, gravel or other

Cotton gin

Pipe lines

Cemeteries

Dams

Fence

Fence along road

Windmills

BOUNDARIES

- National or state
- County
- Land corner
- Reservation
- Land grant

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches — CANAL, DITCH

Lakes and ponds
- Perennial
- Intermittent

Wells — flowing

Springs

Marsh

Wet spot

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

Depressions

SOIL SURVEY DATA

- Soil boundary
- and symbol — Dx
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies

Soil map constructed 1964 by Cartographic Division, Soil Conservation Service, USDA, from 1957 aerial photographs. Controlled mosaic based on Texas plane coordinate system, north central zone, Lambert conformal conic projection. 1927 North American datum.

GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES

[See table 1, p. 7, for approximate acreage and proportionate extent of the soils; table 2, p. 33, for predicted average yields of principal dryland crops; and table 4, p. 40, for those of principal irrigated crops. For information significant to engineering, see section beginning on p. 44]

Map symbol	Mapping unit	Page	Capability unit: Dryland	Page	Capability unit: Irrigated	Page	Range site: Name	Page
AbA	Abilene clay loam, 0 to 1 percent slopes	6	IIce-2	27	(1/)		Deep Hardland	42
AbB	Abilene clay loam, 1 to 3 percent slopes	6	IIIe-2	27	(1/)		Deep Hardland	42
AfA	Amarillo fine sandy loam, 0 to 1 percent slopes	7	IIIe-4	28	IIe-4	37	Sandy Loam	43
AfB	Amarillo fine sandy loam, 1 to 3 percent slopes	7	IIIe-4	28	IIIe-5	39	Sandy Loam	43
AmB	Amarillo loamy fine sand, 0 to 3 percent slopes	8	IVe-4	30	IIIe-7	39	Sandy Land	42
Ba	Badland	8	VIIIs-1	33	(1/)		(2/)	
BfB	Berthoud fine sandy loam, 1 to 3 percent slopes	9	IIIe-6	28	(1/)		Sandy Loam	43
BfC	Berthoud fine sandy loam, 3 to 5 percent slopes	9	IVe-3	29	(1/)		Sandy Loam	43
BfD	Berthoud fine sandy loam, 5 to 8 percent slopes	9	VIe-2	31	(1/)		Sandy Loam	43
BmC	Berthoud loam, 3 to 5 percent slopes	9	IVe-1	29	(1/)		Deep Hardland	42
BmD	Berthoud loam, 5 to 8 percent slopes	9	VIe-1	31	(1/)		Deep Hardland	42
Br	Brownfield fine sand	10	VIe-5	32	(1/)		Deep Sand	43
Bs3	Brownfield soils, severely eroded	10	VIe-5	32	(1/)		Deep Sand	43
BtB	Bippus clay loam, 1 to 3 percent slopes	10	IIe-1	27	(1/)		Deep Hardland	42
DcB	Drake clay loam, 1 to 3 percent slopes	11	IVes-1	31	IIIes-1	40	High Lime	43
DcC	Drake clay loam, 3 to 5 percent slopes	11	VIe-3	32	(1/)		High Lime	43
Hg	Hilly gravelly land	11	VIs-1	32	(1/)		Gravelly	44
Lk	Likes loamy fine sand	11	VIe-5	32	(1/)		Sandy Land	42
Lm	Loamy alluvial land	11	Vw-1	31	(1/)		Loamy Bottom Land	42
Ln	Lofton clay loam	12	IIIce-1	29	IIs-1	37	Deep Hardland	42
Lp	Lofton fine sandy loam	12	IIIe-4	28	IIe-4	37	Sandy Loam	43
MaA	Mansker fine sandy loam, 0 to 1 percent slopes	13	IVe-6	30	IIIe-8	39	Sandy Loam	43
MaB	Mansker fine sandy loam, 1 to 3 percent slopes	13	IVe-6	30	IIIe-8	39	Sandy Loam	43
MaC	Mansker fine sandy loam, 3 to 5 percent slopes	13	VIe-2	31	(1/)		Sandy Loam	43
MkA	Mansker loam, 0 to 1 percent slopes	13	IVe-5	30	IIIe-8	39	Mixed Plains	42
MkB	Mansker loam, 1 to 3 percent slopes	13	IVe-5	30	IIIe-8	39	Mixed Plains	42
MkC	Mansker loam, 3 to 5 percent slopes	13	VIe-1	31	(1/)		Mixed Plains	42
Ml	Mansker-Potter complex	13	-----	--	(1/)	--	------------	
	Mansker soil	--	VIe-2	31	------		Sandy Loam	43
	Potter soil	--	VIIs-1	32	------		Very Shallow	43
MmB	Miles loamy fine sand, 0 to 3 percent slopes	15	IVe-4	30	IIIe-7	39	Sandy Land	42
MmC	Miles loamy fine sand, 3 to 5 percent slopes	15	VIe-5	32	(1/)		Sandy Land	42
MnA	Miles fine sandy loam, 0 to 1 percent slopes	14	IIIe-4	28	IIe-4	37	Sandy Loam	43
MnB	Miles fine sandy loam, 1 to 3 percent slopes	15	IIIe-4	28	IIe-6	37	Sandy Loam	43
MnC	Miles fine sandy loam, 3 to 5 percent slopes	15	IVe-2	29	(1/)		Sandy Loam	43
OtA	Olton loam, 0 to 1 percent slopes	15	IIIce-2	29	IIe-1	36	Deep Hardland	42
OtB	Olton loam, 1 to 3 percent slopes	16	IIIe-2	27	IIIe-2	38	Deep Hardland	42
PfA	Portales fine sandy loam, 0 to 1 percent slopes	16	IIIe-5	28	IIe-5	37	Mixed Plains	42
PfB	Portales fine sandy loam, 1 to 3 percent slopes	16	IIIe-5	28	IIIe-6	39	Mixed Plains	42
PmA	Portales loam, 0 to 1 percent slopes	17	IIIe-5	28	IIe-3	37	Mixed Plains	42
PmB	Portales loam, 1 to 3 percent slopes	17	IIIe-3	28	IIIe-4	39	Mixed Plains	42
Ps	Potter soils	17	VIIs-1	32	(1/)		Very Shallow	43
PuA	Pullman silty clay loam, 0 to 1 percent slopes	17	IIIce-1	29	IIs-1	37	Deep Hardland	42
PuB	Pullman silty clay loam, 1 to 3 percent slopes	17	IIIe-1	27	IIIe-1	38	Deep Hardland	42
Ra	Randall clay	18	VIw-1	32	(1/)		(2/)	
Rf	Randall fine sandy loam	18	IVw-1	31	(1/)		(2/)	
Rm	Rough broken land	18	VIIs-2	32	(1/)		Rough Breaks	43
Sa	Sandy alluvial land	19	Vw-2	31	(1/)		Sandy Bottom Land	44
Sc	Spur clay loam	19	IIce-1	27	I-1	36	Loamy Bottom Land	42
Sf	Spur fine sandy loam	19	IIIe-4	28	I-2	36	Loamy Bottom Land	42
SmB	Stamford clay, 1 to 3 percent slopes	19	IVe-8	30	(1/)		Clay Flat	44
StA	Stamford soils, 0 to 1 percent slopes	19	IIIs-1	29	(1/)		Deep Hardland	42
Tv	Tivoli fine sand	20	VIIe-1	32	(1/)		Deep Sand	43
Vb	Vernon-Travessilla complex	20	------		(1/)		-------------	
	Vernon soil	--	VIe-4	32	----		Shallow Redland	44
	Travessilla soil	--	VIIs-1	32	----		Very Shallow	43
VcB	Vernon clay loam, 1 to 3 percent slopes	20	IVe-7	30	(1/)		Shallow Redland	44
VcD	Vernon clay loam, 3 to 15 percent slopes	20	VIe-4	32	(1/)		Shallow Redland	44
ZfA	Zita fine sandy loam, 0 to 1 percent slopes	21	IIIe-4	28	IIe-4	37	Sandy Loam	43
ZmA	Zita loam, 0 to 1 percent slopes	21	IIIce-2	29	IIe-2	36	Deep Hardland	42
ZmB	Zita loam, 1 to 3 percent slopes	21	IIIe-2	27	IIIe-3	38	Deep Hardland	42

1/ This mapping unit is not suitable for irrigation; or irrigation water is not available.

2/ Not assigned to a range site.

765-184 O - 66 (Face p. 70)

1

N

(Joins sheet 2)

(Joins sheet 8)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

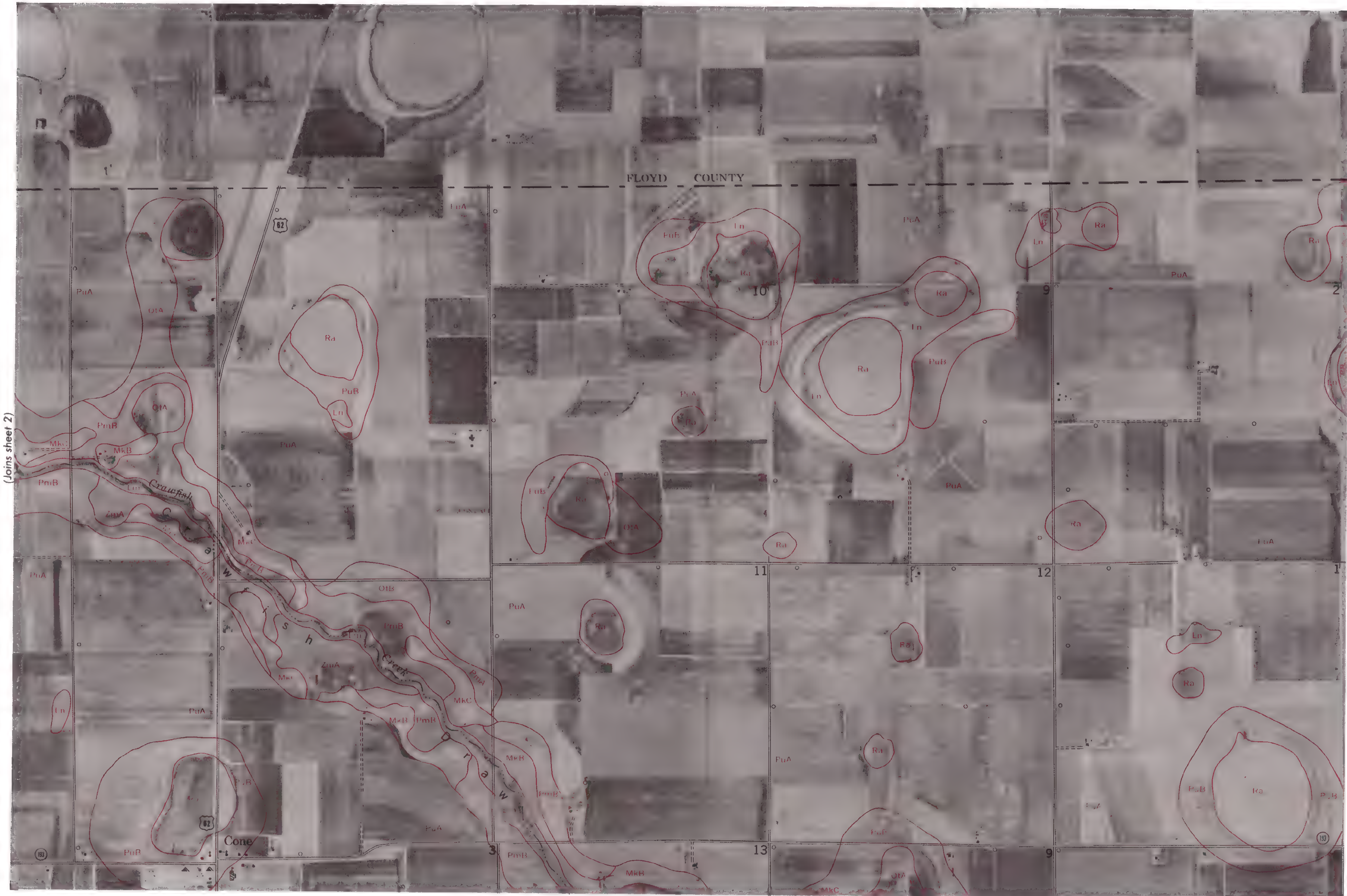
This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

Land division corners and numbers shown on this map are indefinite.


2
N
FLOYD COUNTY
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 9)
Crawfish Creek
217
210
209
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

Land division corners and numbers shown on this map are indefinite.



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet


4
N
FLOYD COUNTY
White River
HANK SMITH STONE HOUSE
PuA
Ra
PuB
MkC
MkB
Ln
Lm
Ps
Ml
BtB
BtD
BmC
BmD
17
18
28
29
16
15
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 11)
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

N

(Joins sheet 4)

(Joins sheet 6)

(Joins sheet 12)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

6

(Joins sheet 13)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

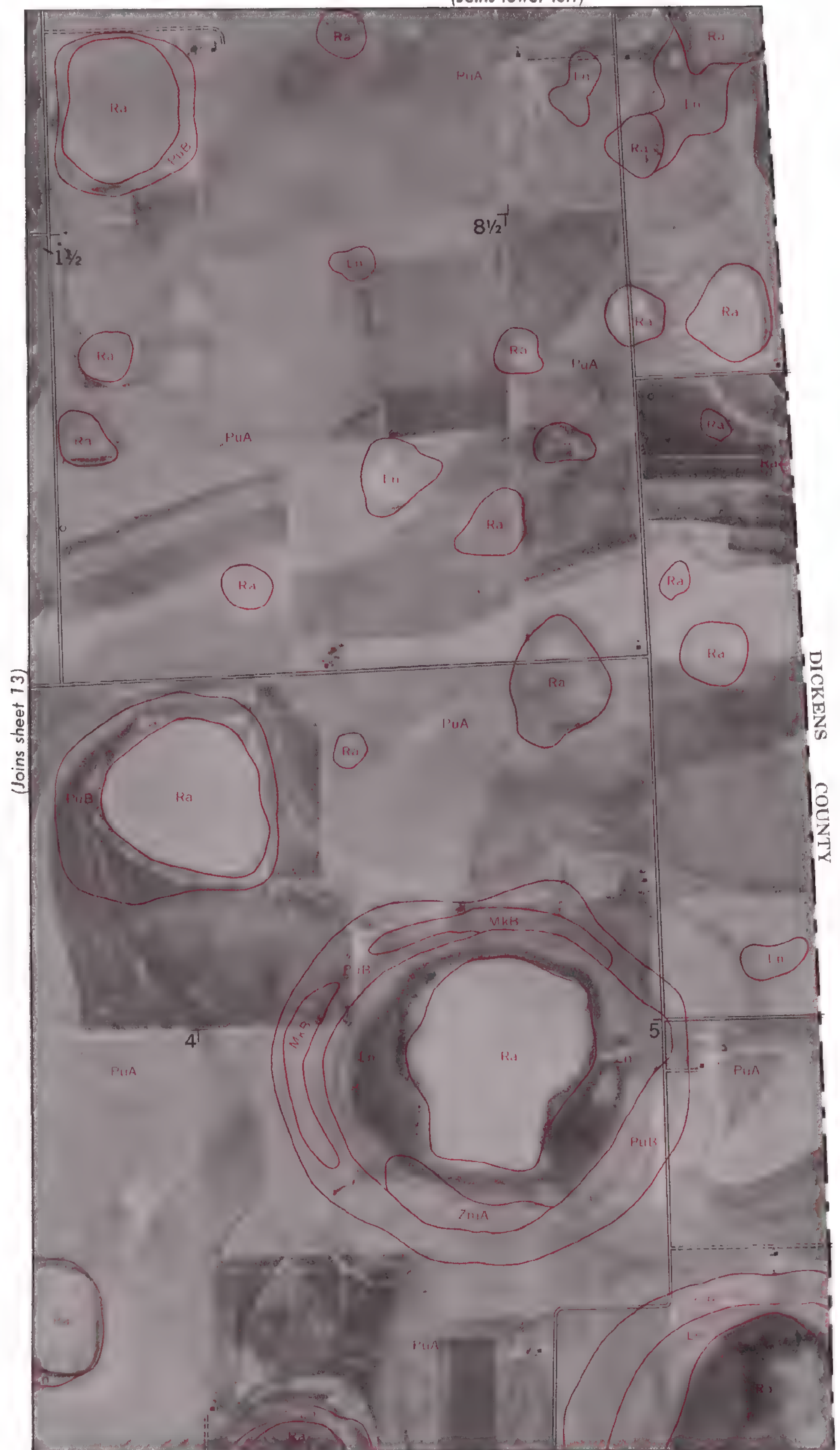
N

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

Land division corners and numbers shown on this map are indefinite.

(Joins upper right)

(Joins lower left)



(Joins sheet 20)

0 ½ 1 Mile

Scale 1:20 000

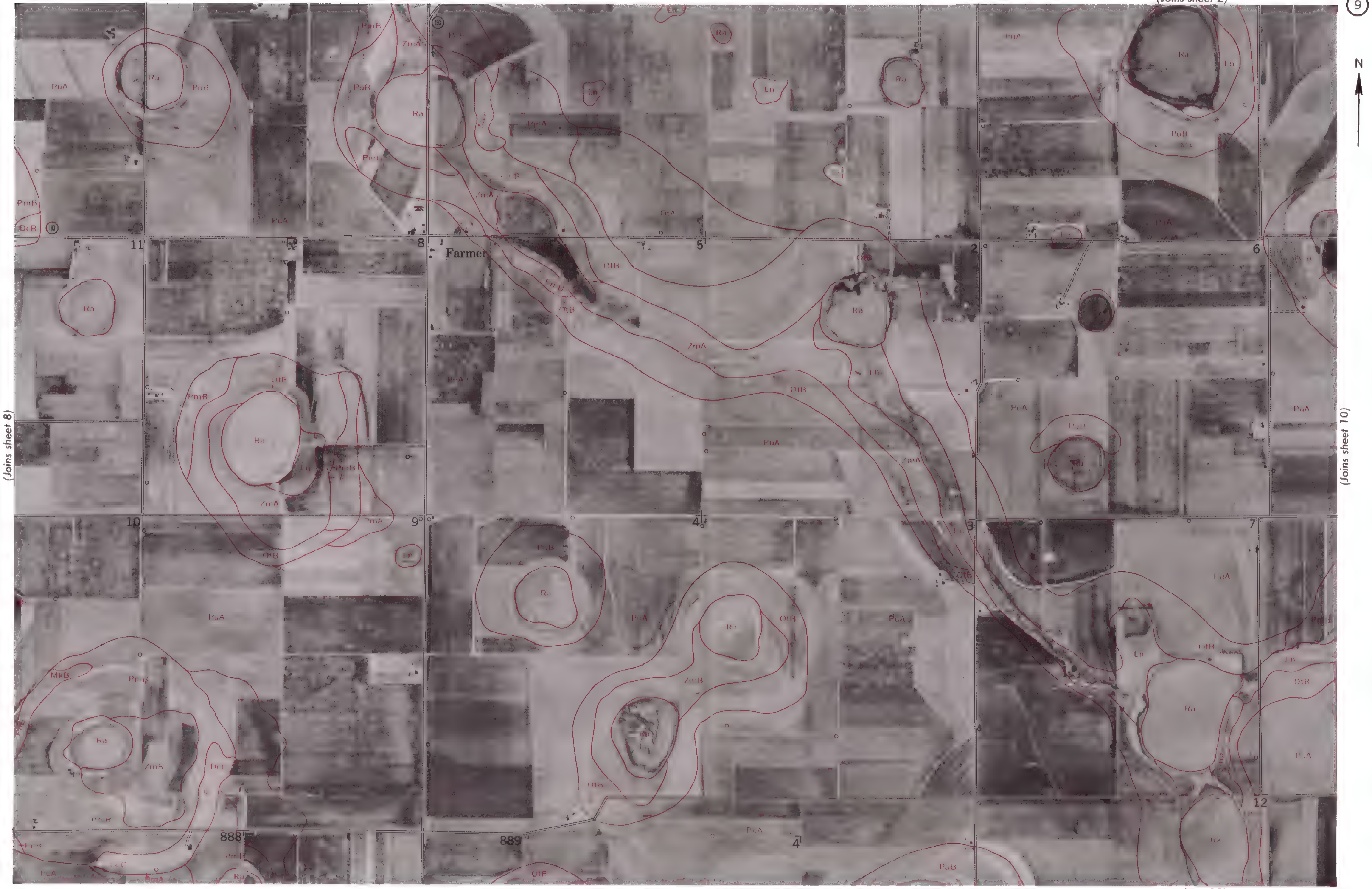
0 5000 Feet

CROSBY COUNTY, TEXAS — SHEET NUMBER 8

(Joins sheet 2)

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.
Land division corners and numbers shown on this map are indefinite.

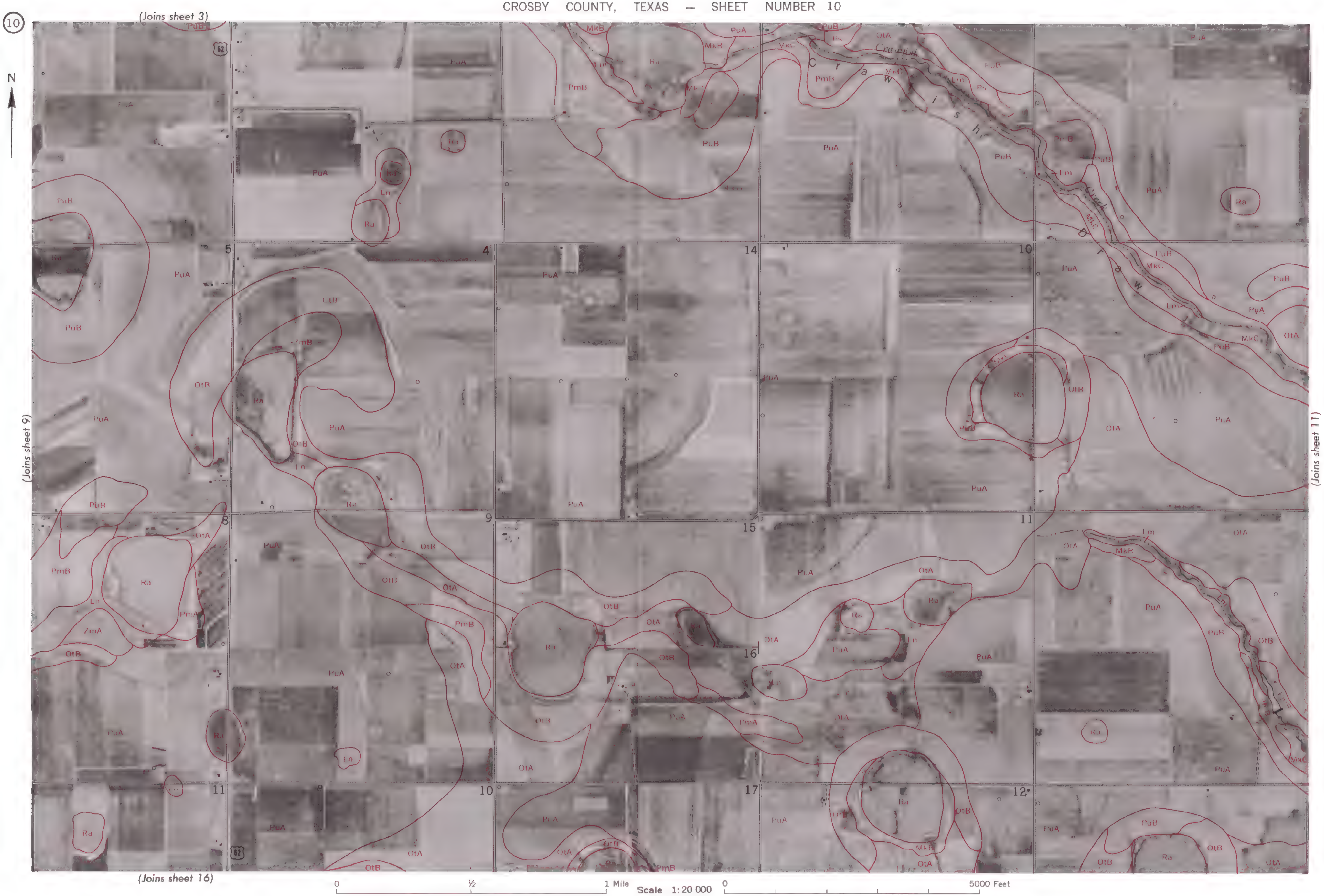
(Joins sheet 8)



(Joins sheet 10)

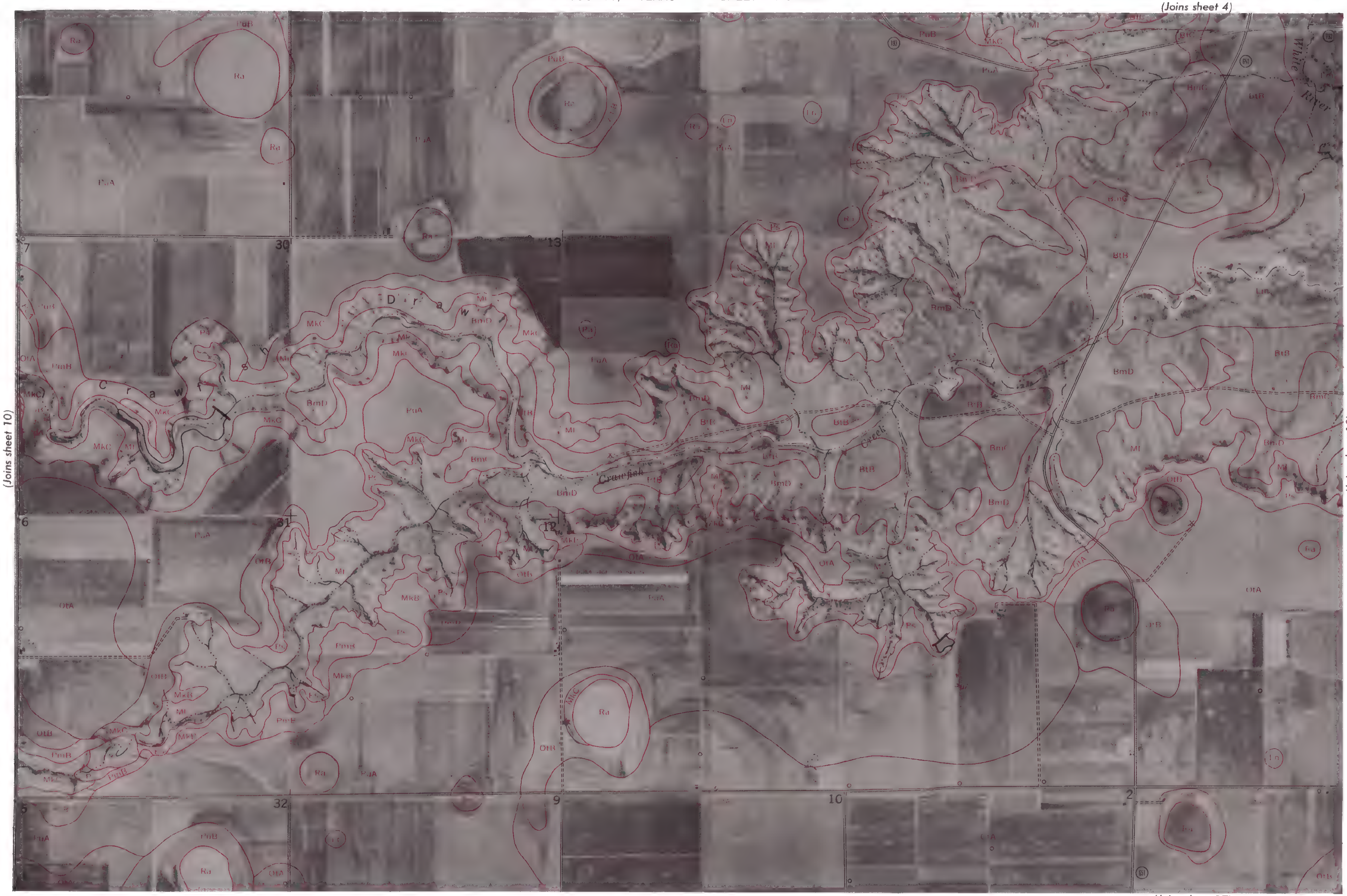
(Joins sheet 15)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet


10
(Joins sheet 3)
N
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 16)
62
Crawfish Creek
Draw
PuA
PuB
PmB
MkB
MkC
Ra
Ln
Lm
OtA
OtB
ZmA
PmA
5
4
14
10
8
9
15
11
16
12
17
0
½
1 Mile
Scale 1:20 000
5000 Feet

(Joins sheet 4)

11



(Joins sheet 10)

(Joins sheet 12)

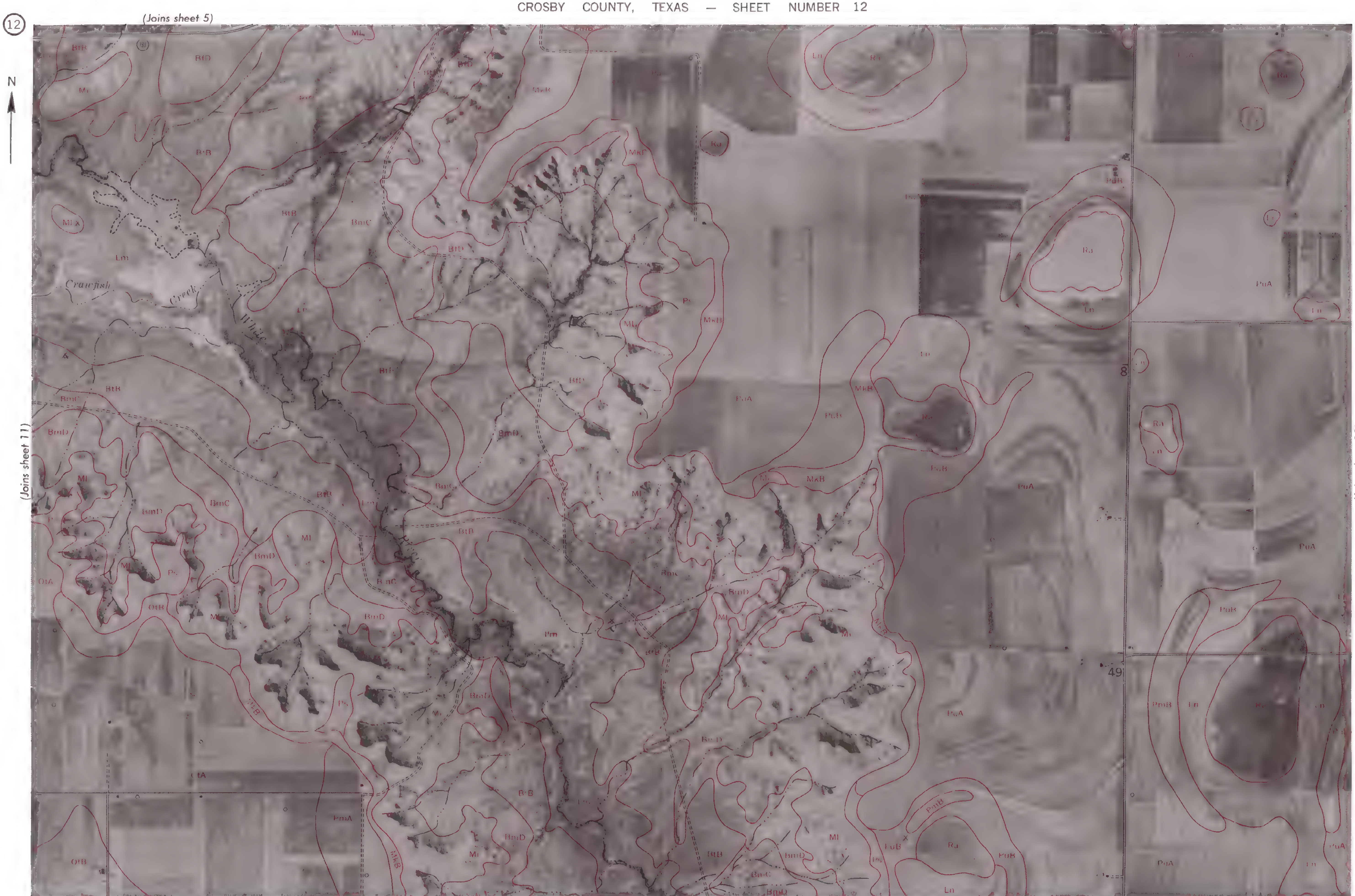
(Joins sheet 17)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

Land division corners and numbers shown on this map are indefinite.

(Joins sheet 5)



(Joins sheet 18)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

CROSBY COUNTY, TEXAS — SHEET NUMBER 13

(Joins sheet 6)

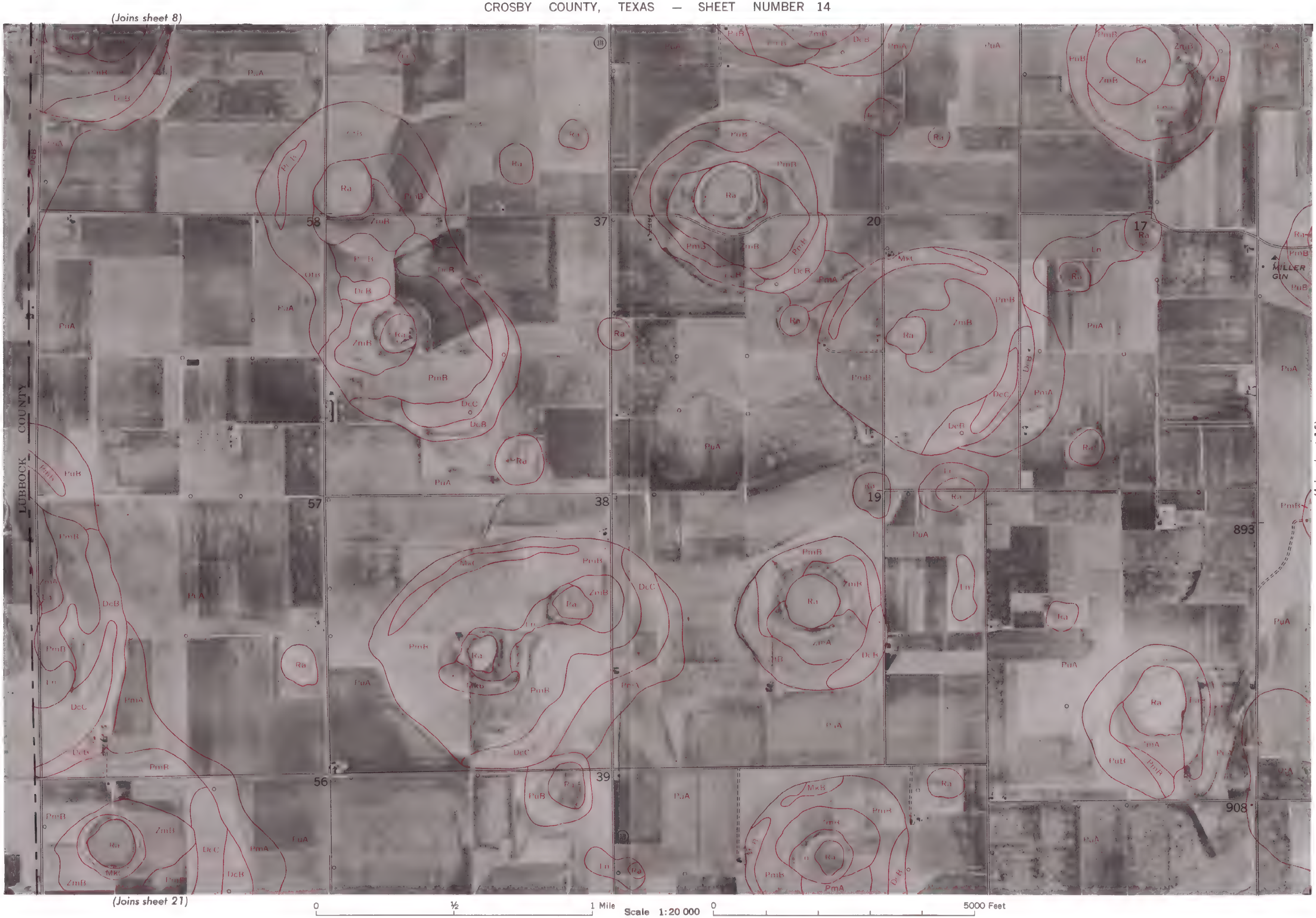
13

(Joins sheet 19)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

Land division corners and numbers shown on this map are indefinite


(Joins sheet 8)
N
LUBBOCK COUNTY
(Joins sheet 15)
(Joins sheet 21)
MILLER GIN
58
37
20
17
57
38
19
893
56
39
908
PuA
PmB
ZmB
DcB
DcC
Ra
Ln
PmA
MxC
MxB
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

(Joins sheet 9)

15

N

(Joins sheet 14)

(Joins sheet 16)

(Joins sheet 22)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

16

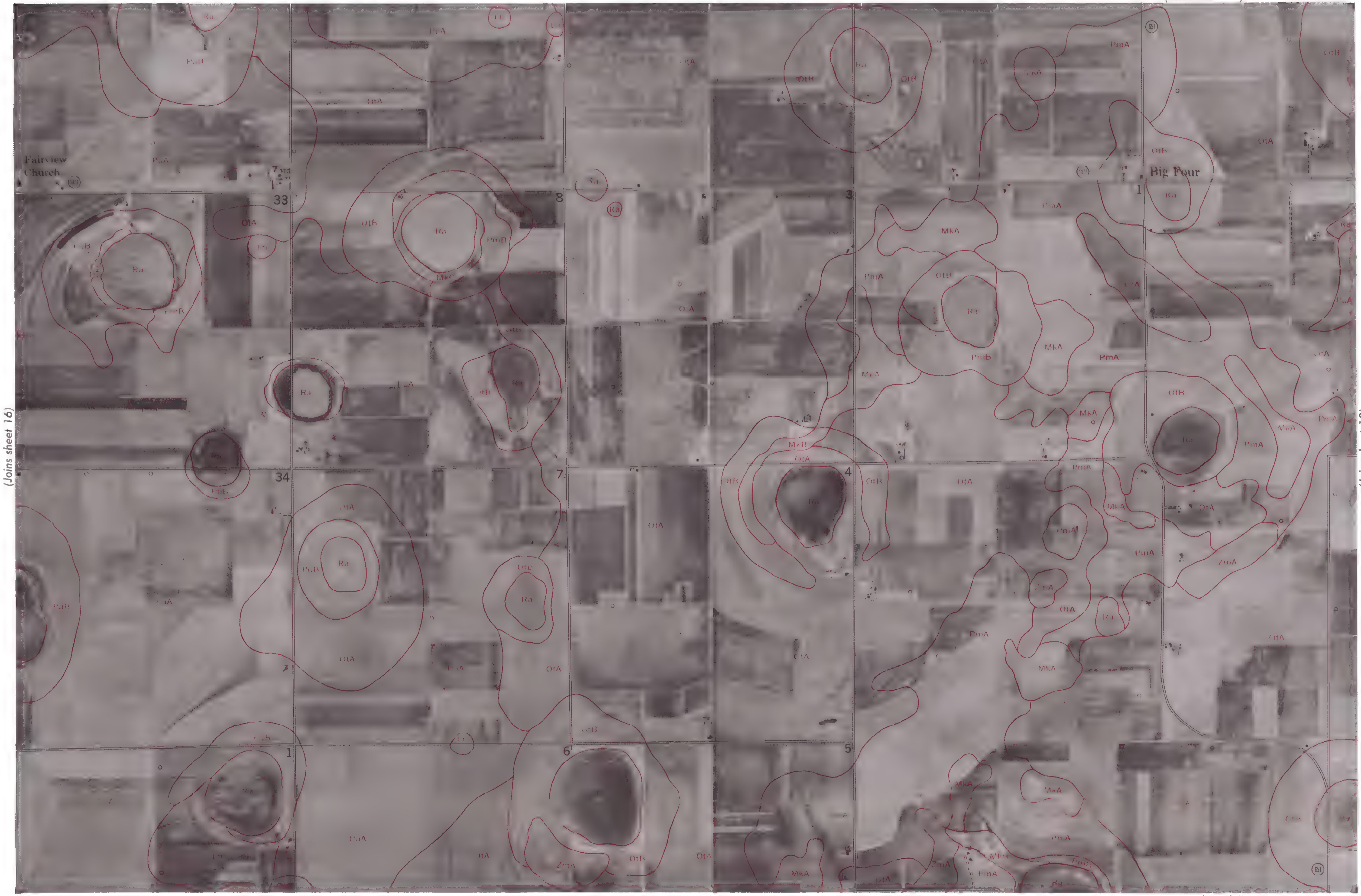
(Joins sheet 10)

(Joins sheet 23)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 11)

(Joins sheet 16)



(Joins sheet 18)

(Joins sheet 24)

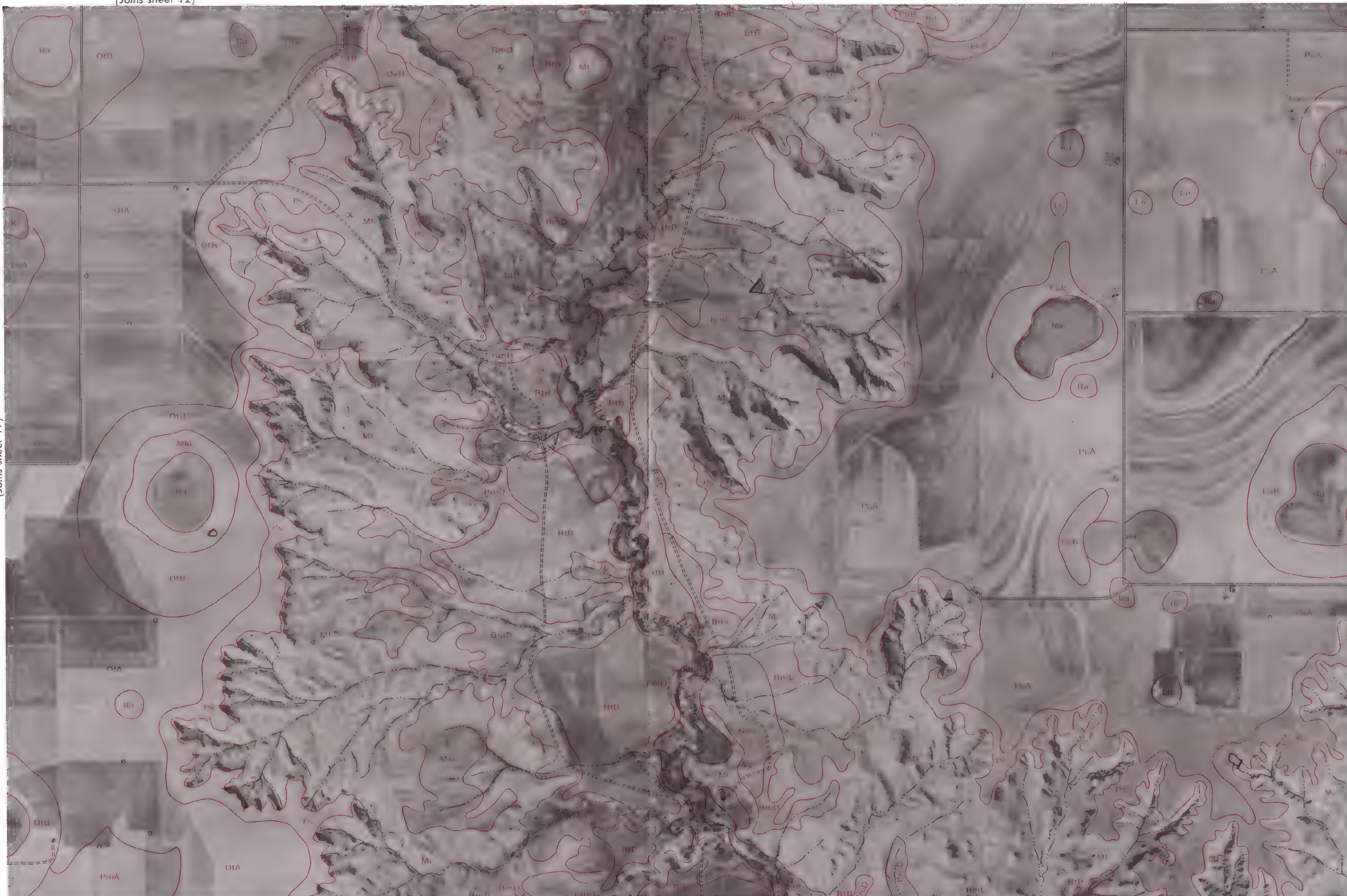
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

(18)

(Joins sheet 12)



(Joins sheet 25)

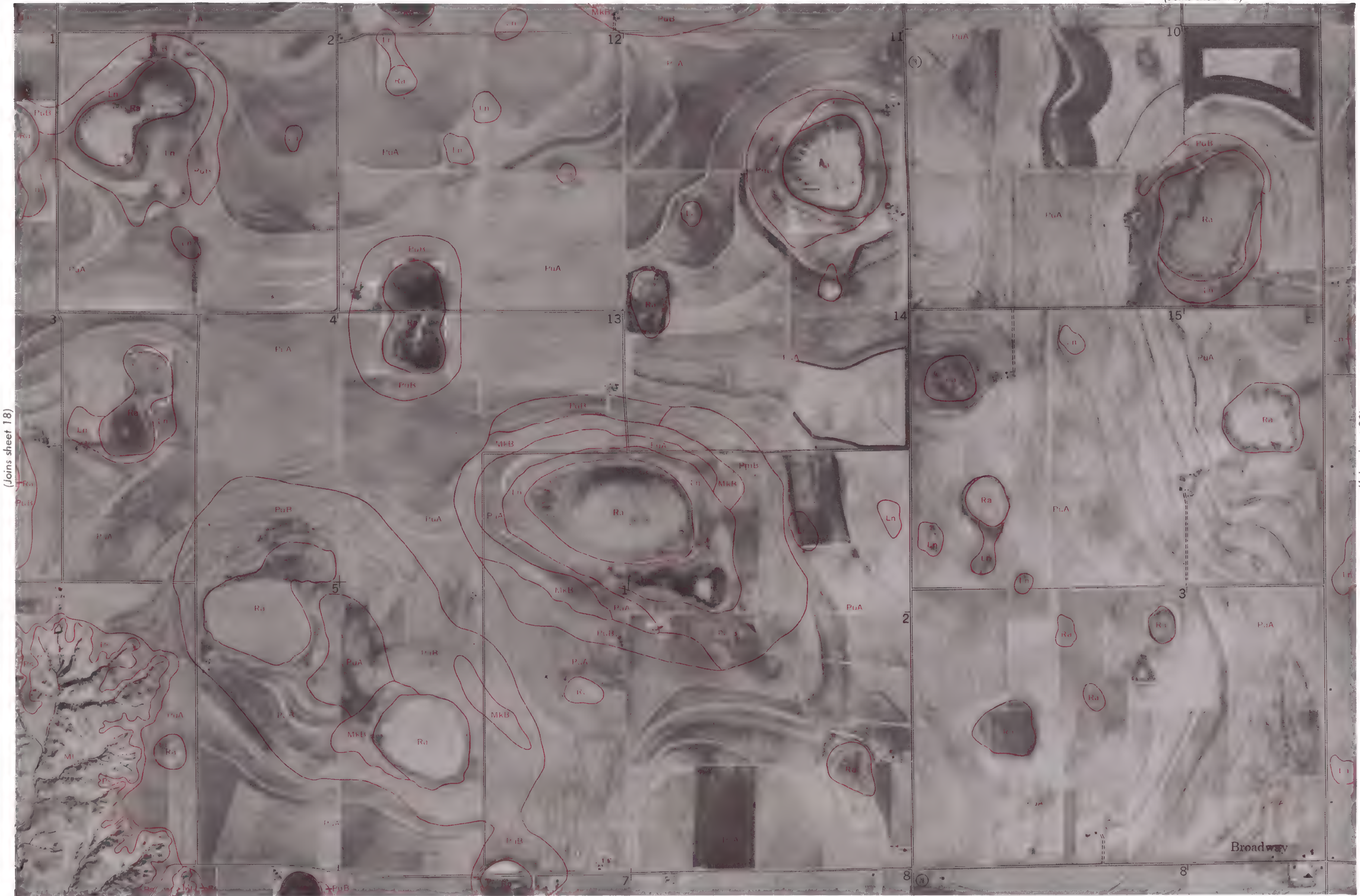
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

CROSBY COUNTY, TEXAS — SHEET NUMBER 19

(Joins sheet 13)

19

(Joins sheet 18)



(Joins sheet 20)

(Joins sheet 26)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

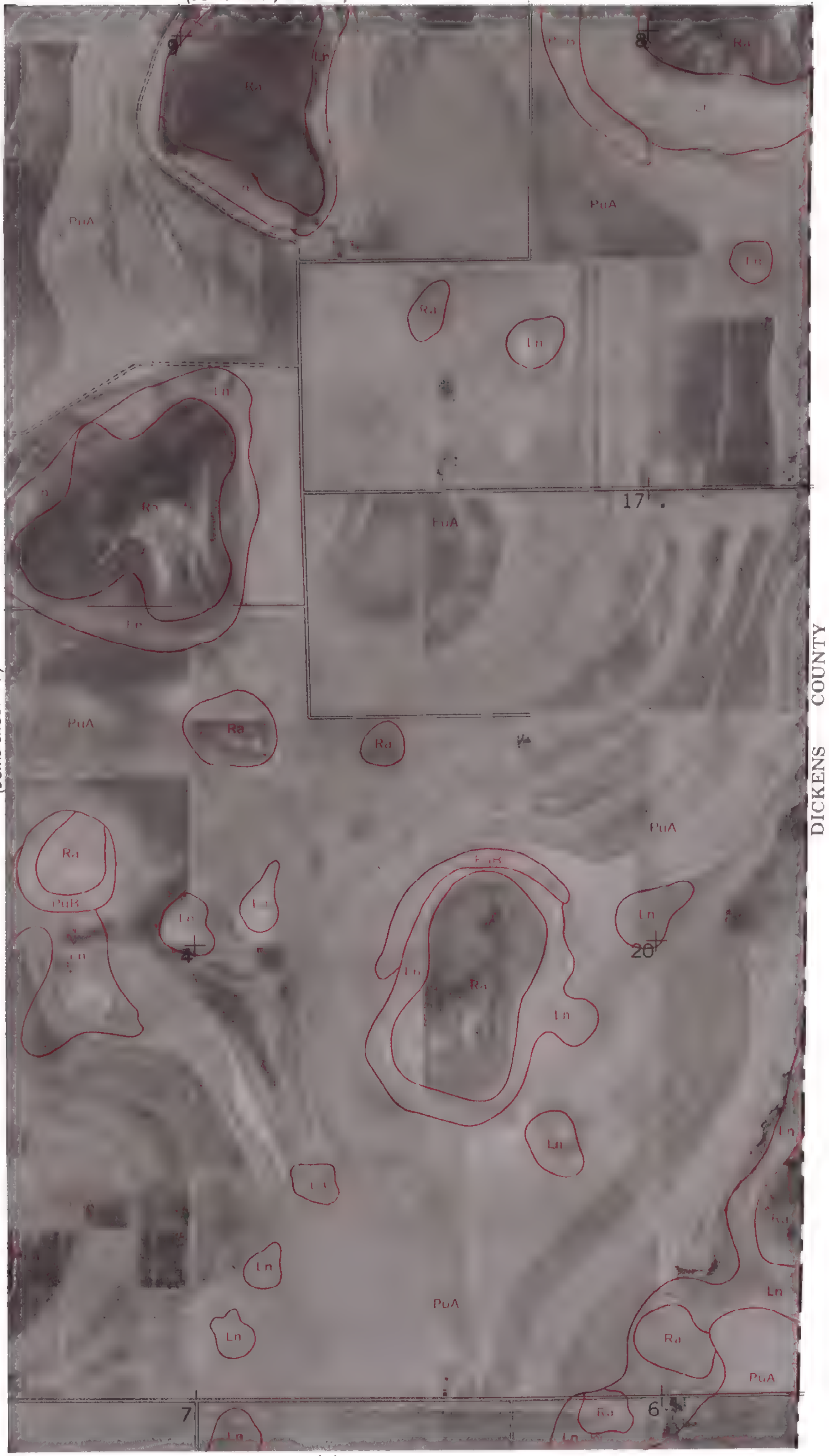
This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

Land division corners and numbers shown on this map are indefinite

N

(Joins inset, sheet 7)

(Joins sheet 19)



(Joins upper right)

(Joins lower left)

(Joins sheet 26)

(Joins sheet 33)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(Joins sheet 14)

21

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

N

(Joins sheet 22)

(Joins sheet 27)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

22

(Joins sheet 15)

N

(Joins sheet 21)

(Joins sheet 23)

(Joins sheet 28)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 16)

(Joins sheet 22)

(Joins sheet 24)

(Joins sheet 29)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

Land division corners and numbers shown on this map are indefinite.

24

(Joins sheet 17)

N

(Joins sheet 23)

(Joins sheet 25)

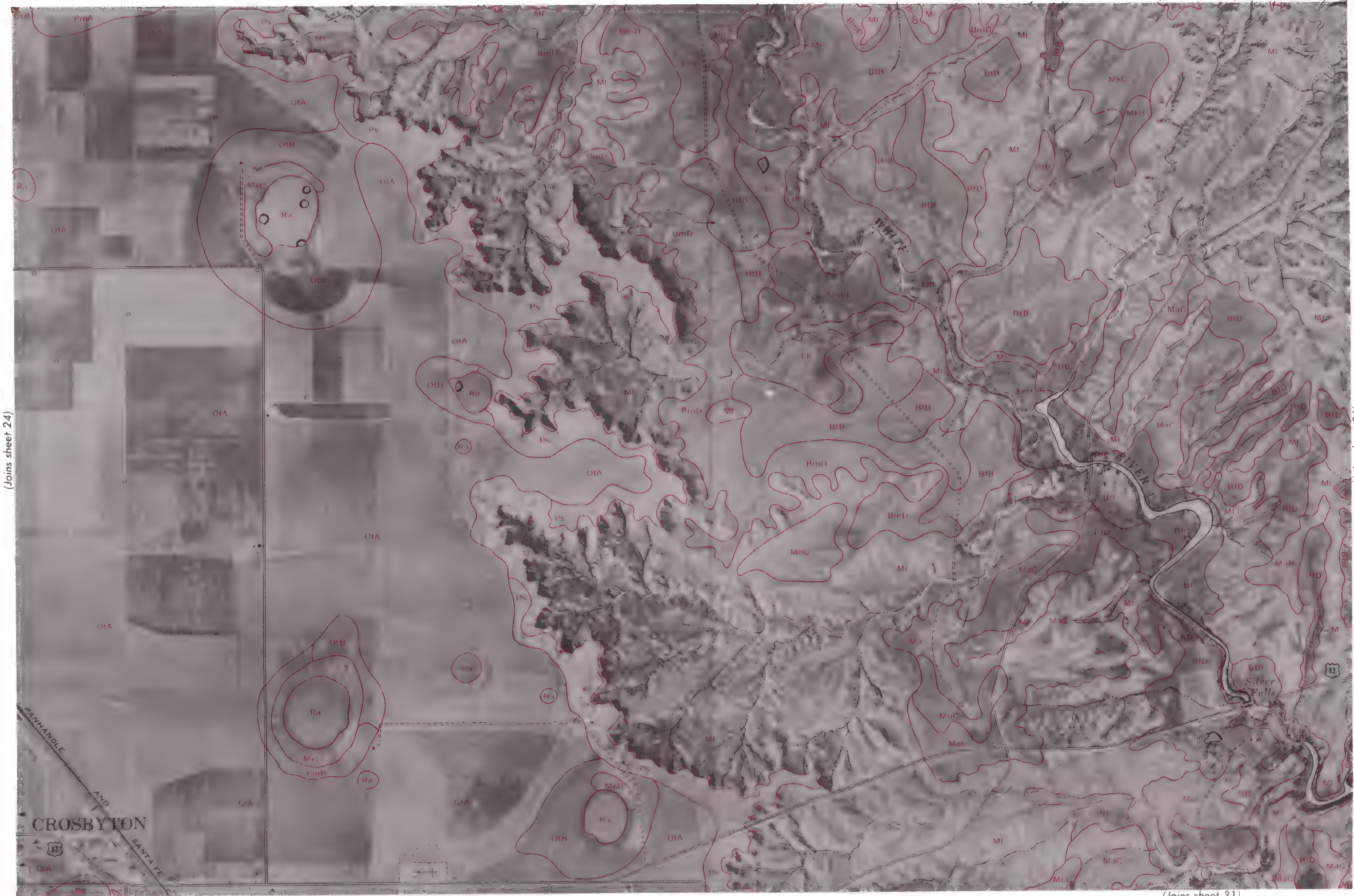
(Joins sheet 30)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 18)

(Joins sheet 24)

(Joins sheet 26)



(Joins sheet 31)

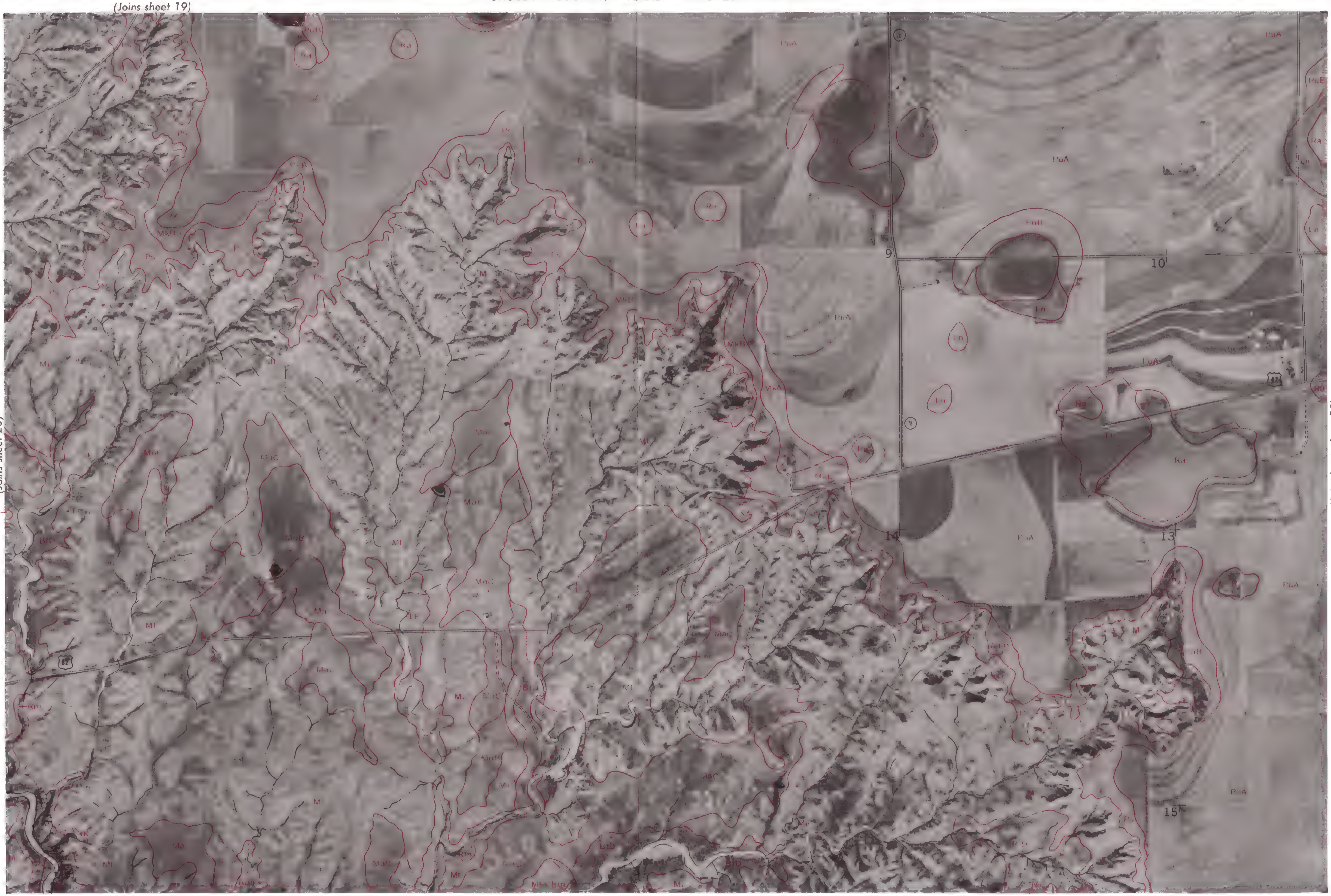
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

26

(Joins sheet 19)



(Joins sheet 25)

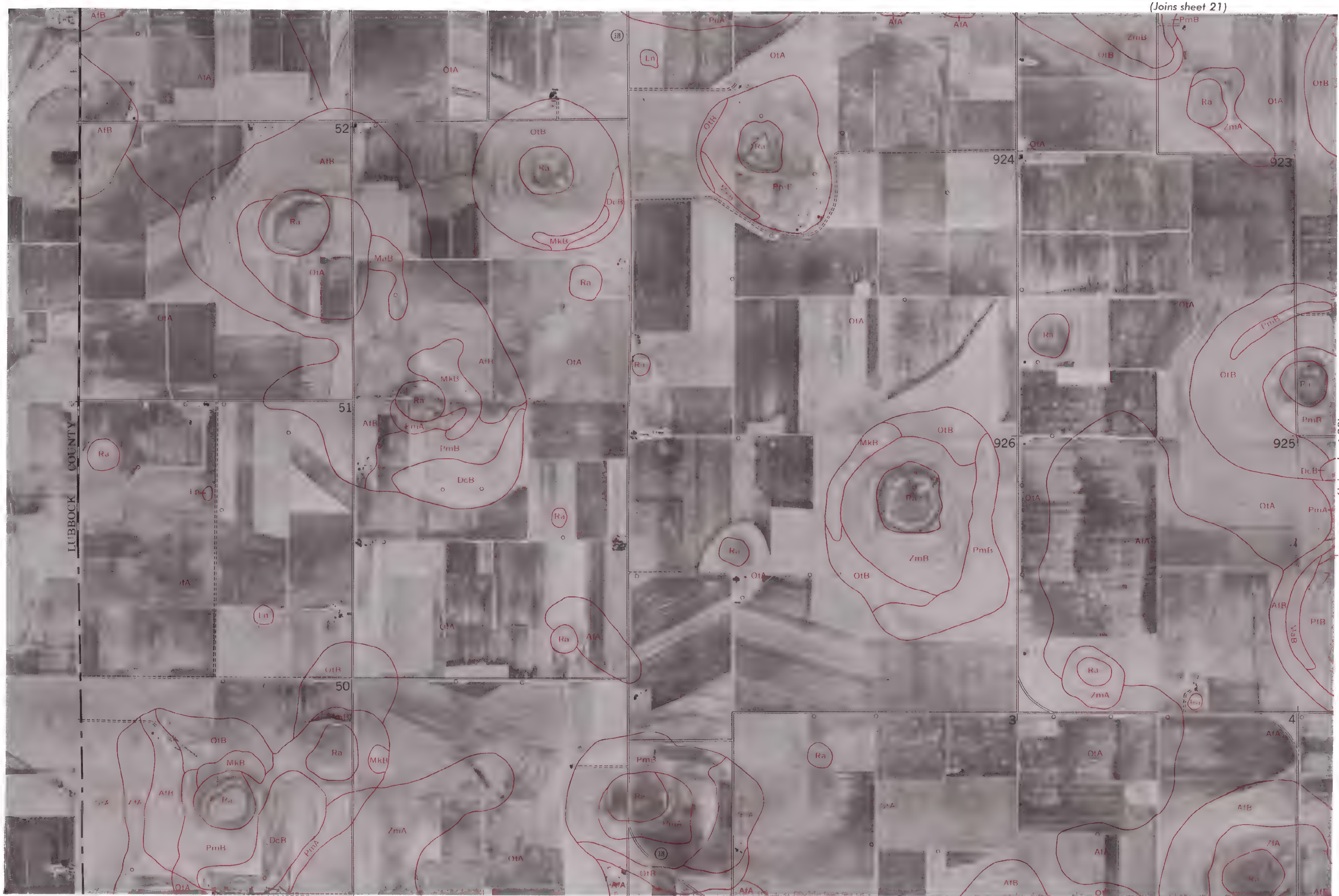
(Joins inset, sheet 20)

(Joins sheet 32)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 21)

27



(Joins sheet 28)

(Joins sheet 34)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.
Land division corners and numbers shown on this map are indefinite.

CROSBY COUNTY, TEXAS — SHEET NUMBER 28

(Joins sheet 22)

N

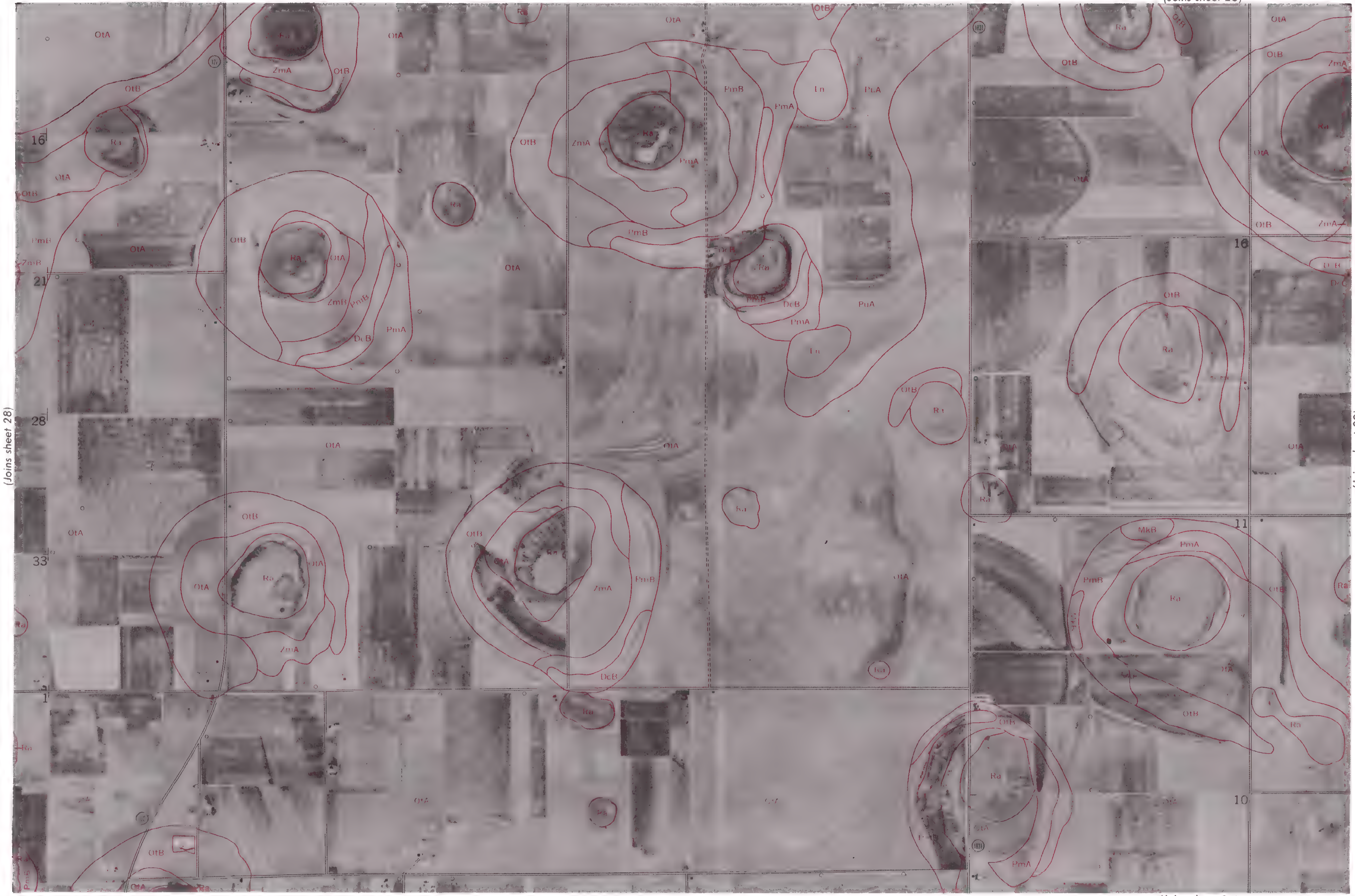
(Joins sheet 27)

(Joins sheet 29)

(Joins sheet 35)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(29)



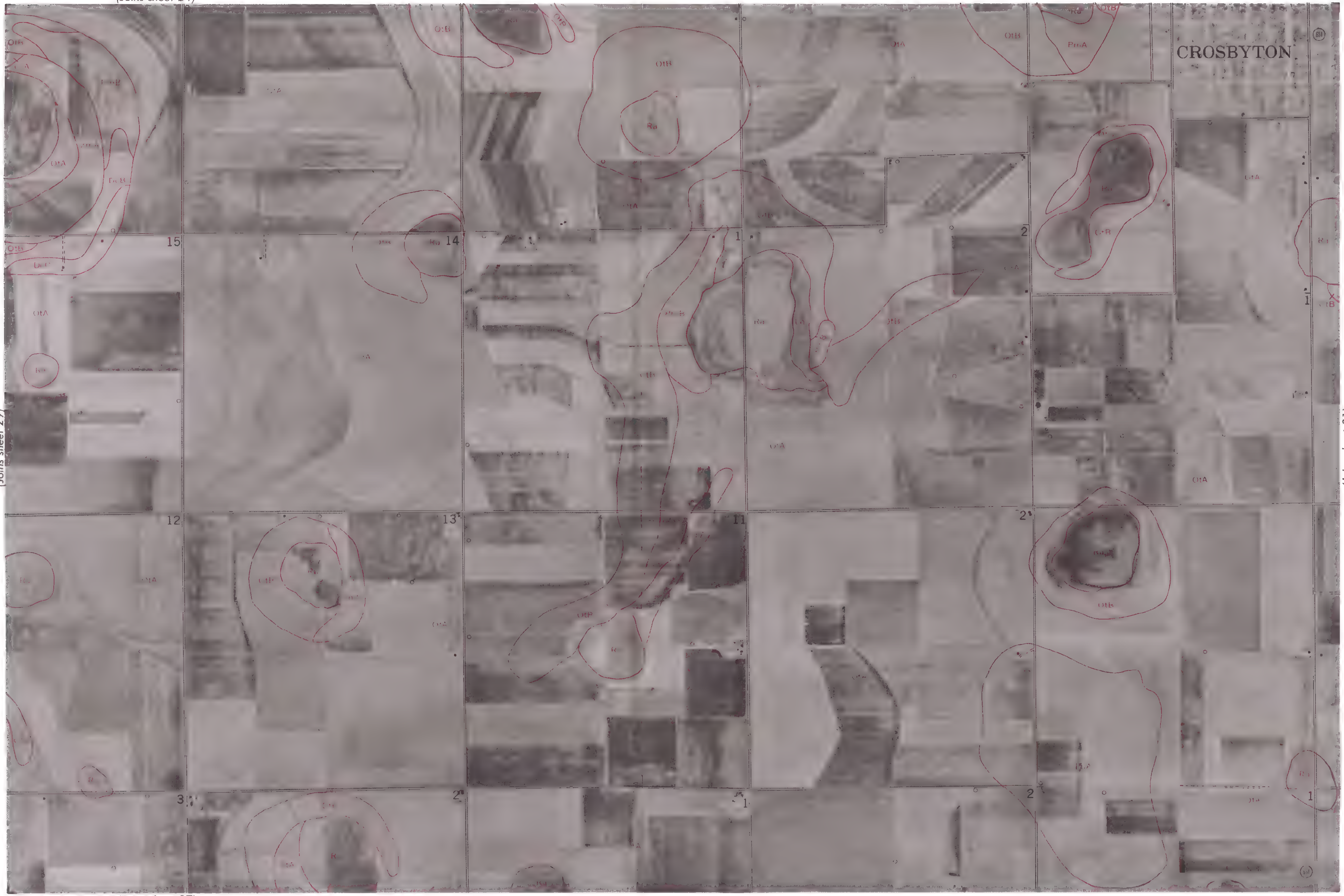
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

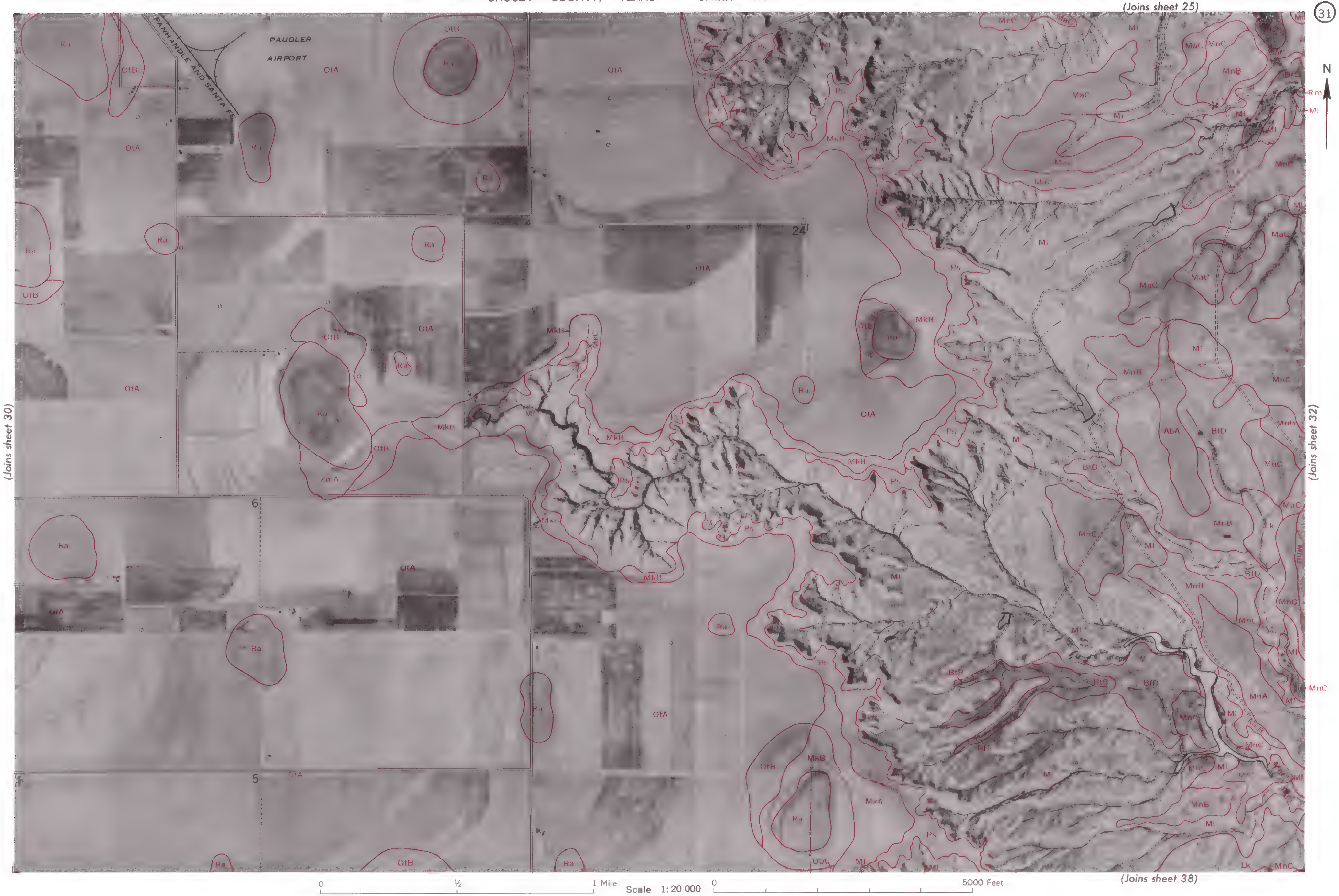
30

(Joins sheet 24)



(Joins sheet 37)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



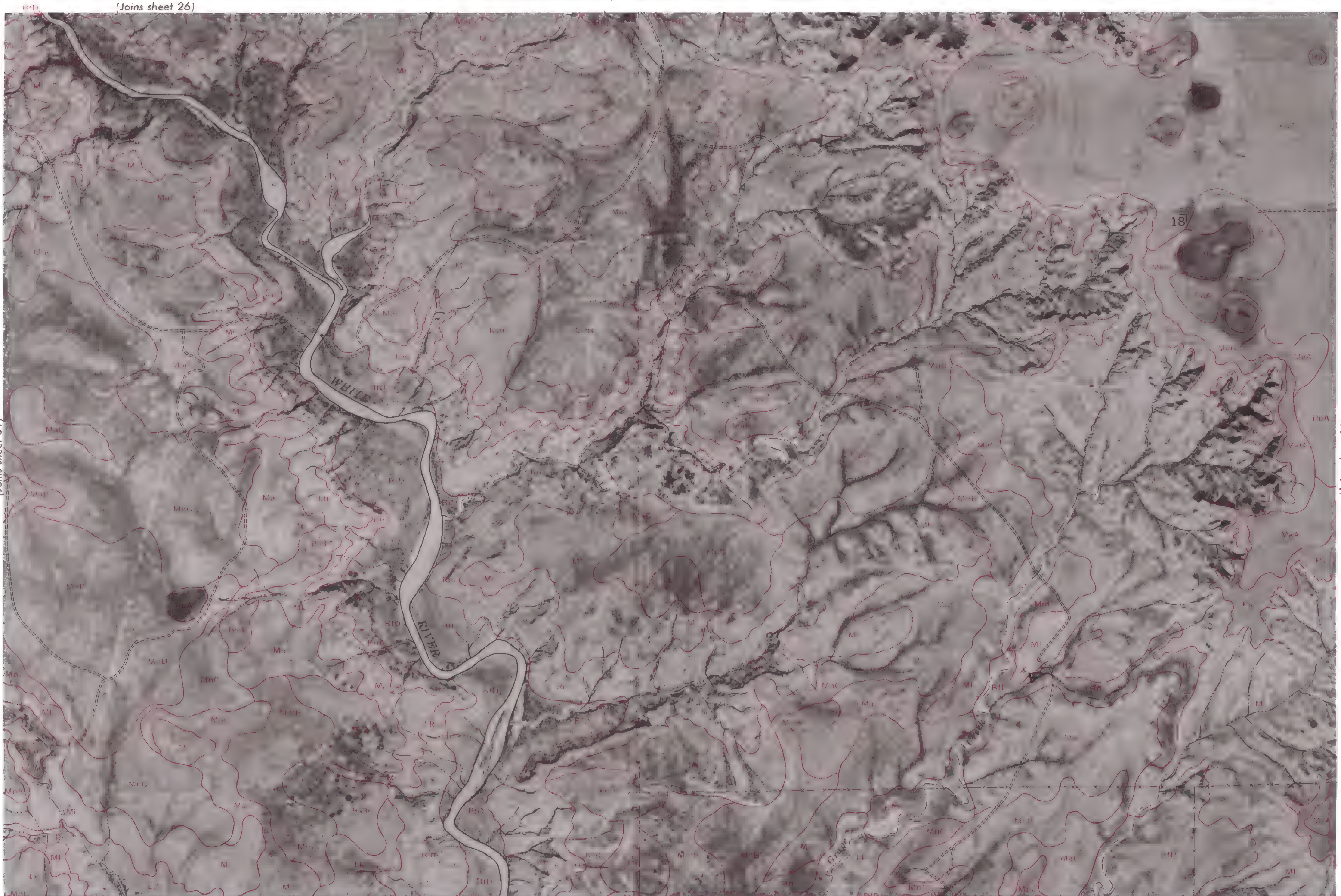
This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

Land division corners and numbers shown on this map are indefinite.

32

(Joins sheet 26)

N



(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 39)

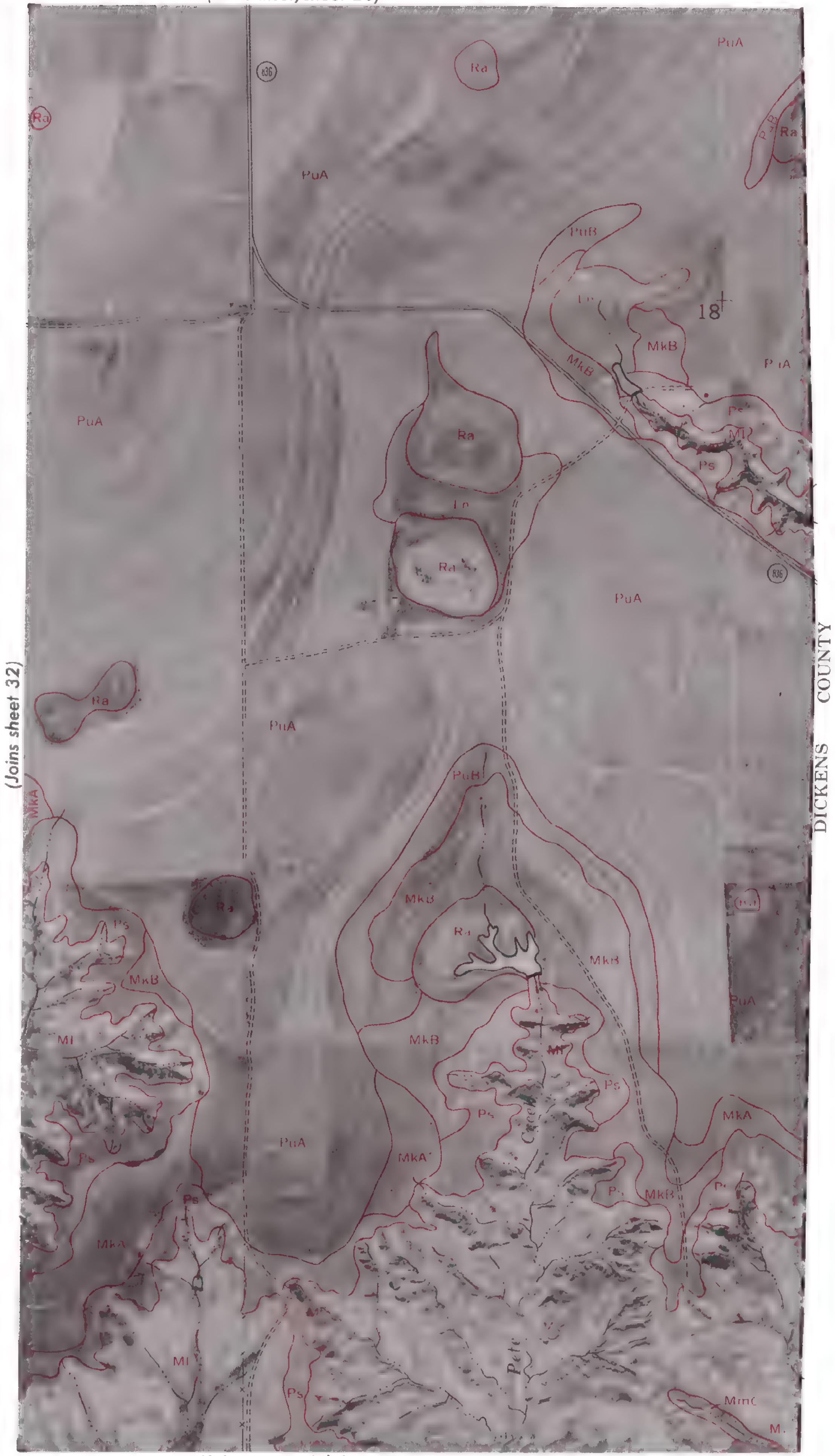
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

(Joins inset, sheet 20)

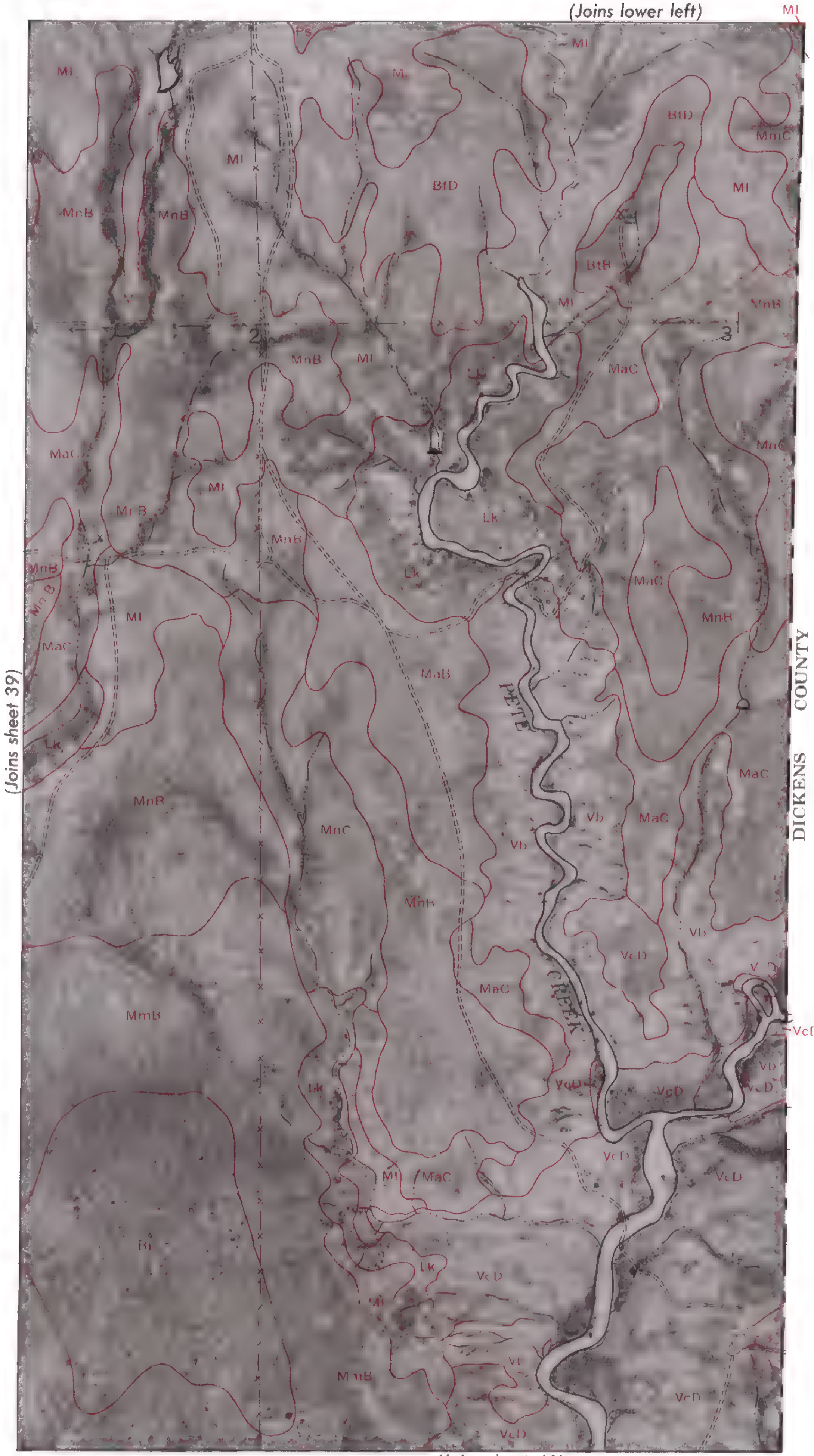
(Joins sheet 32)



(Joins upper right)

(Joins lower left)

(Joins sheet 39)



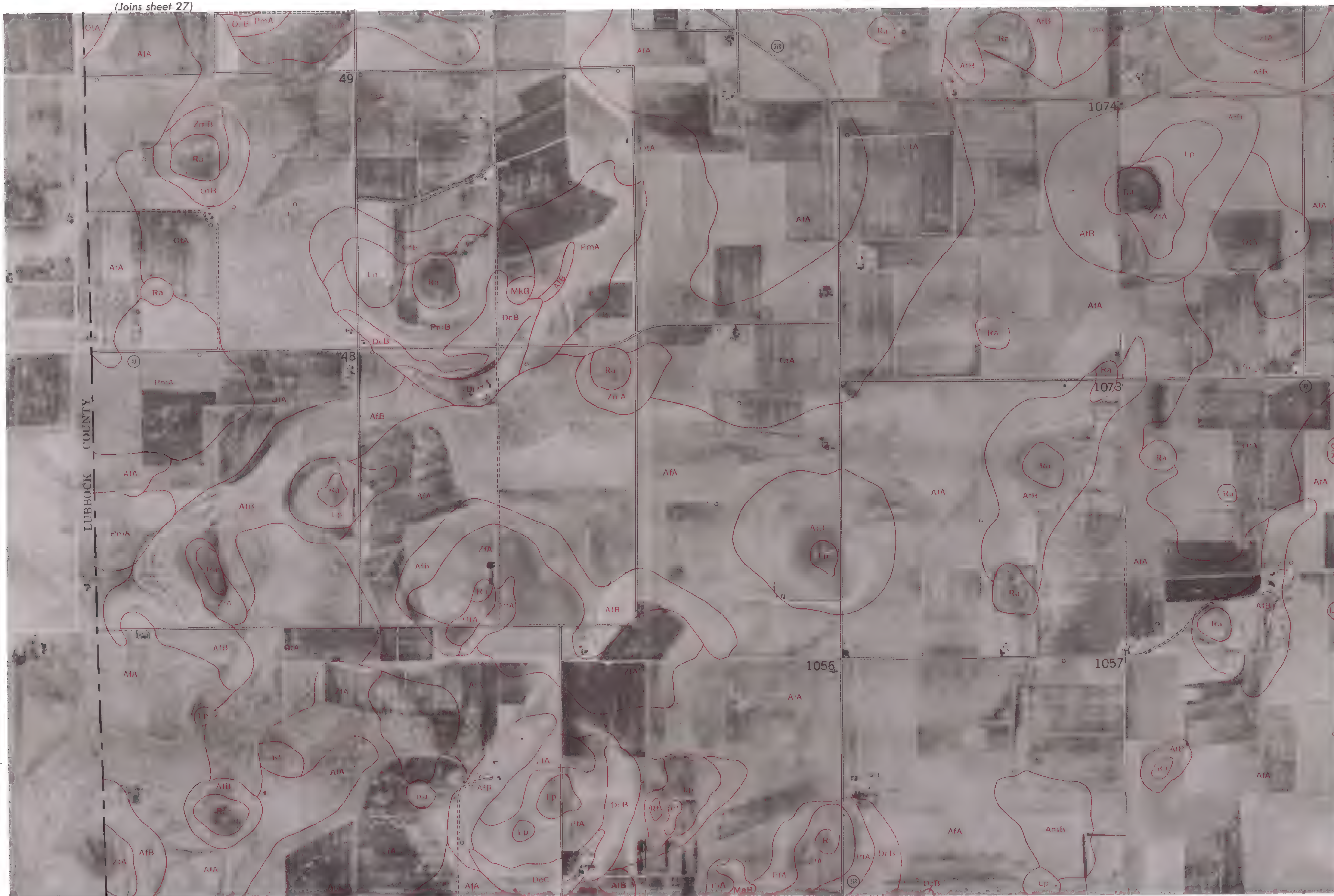
(Joins sheet 46)

N

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(34)

(Joins sheet 27)

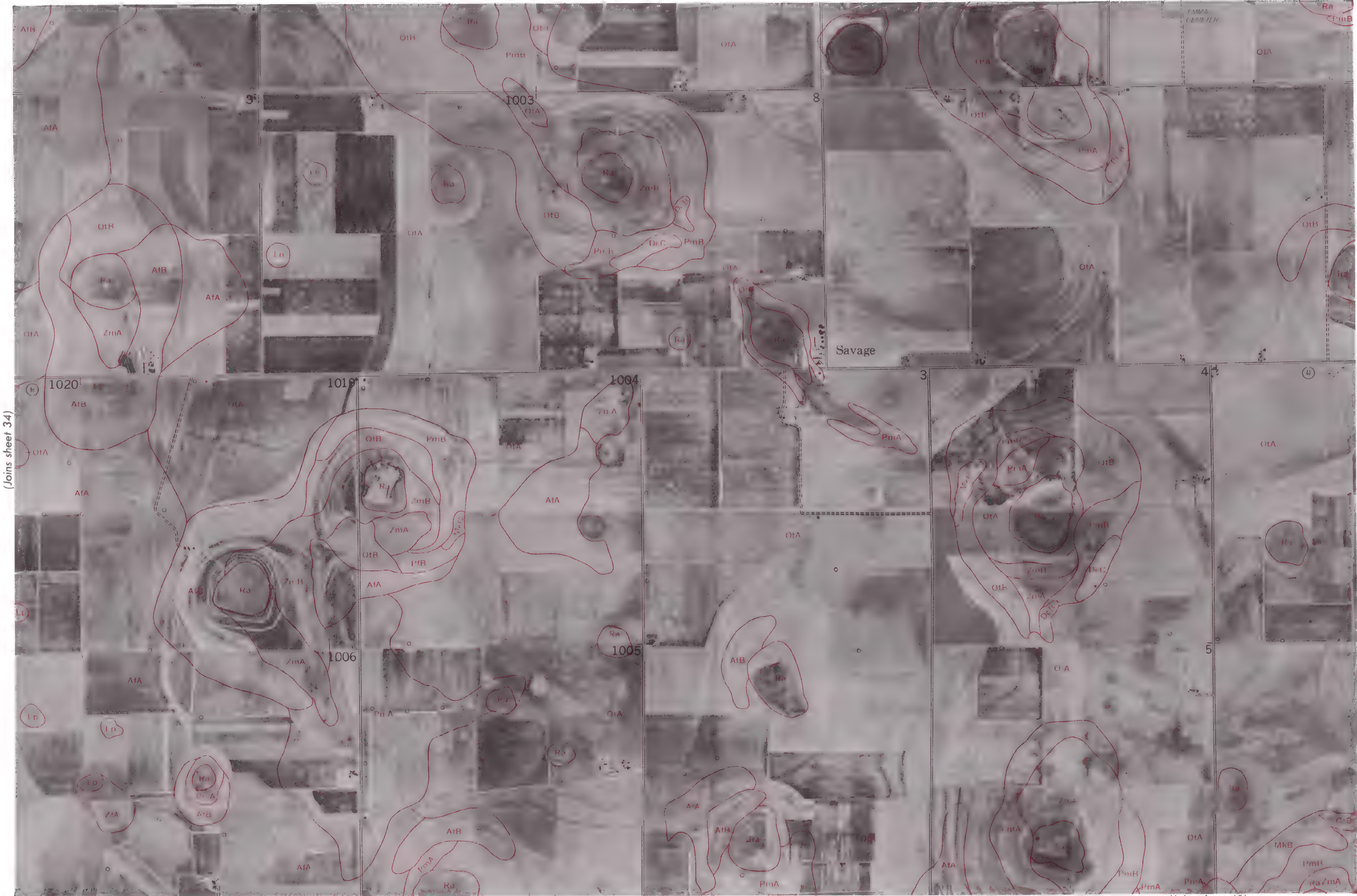


(Joins sheet 40)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 28)

(Joins sheet 34)



(Joins sheet 36)

(Joins sheet 41)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

CROSBY COUNTY, TEXAS — SHEET NUMBER 36

(Joins sheet 29)

N

(Joins sheet 35)

(Joins sheet 37)

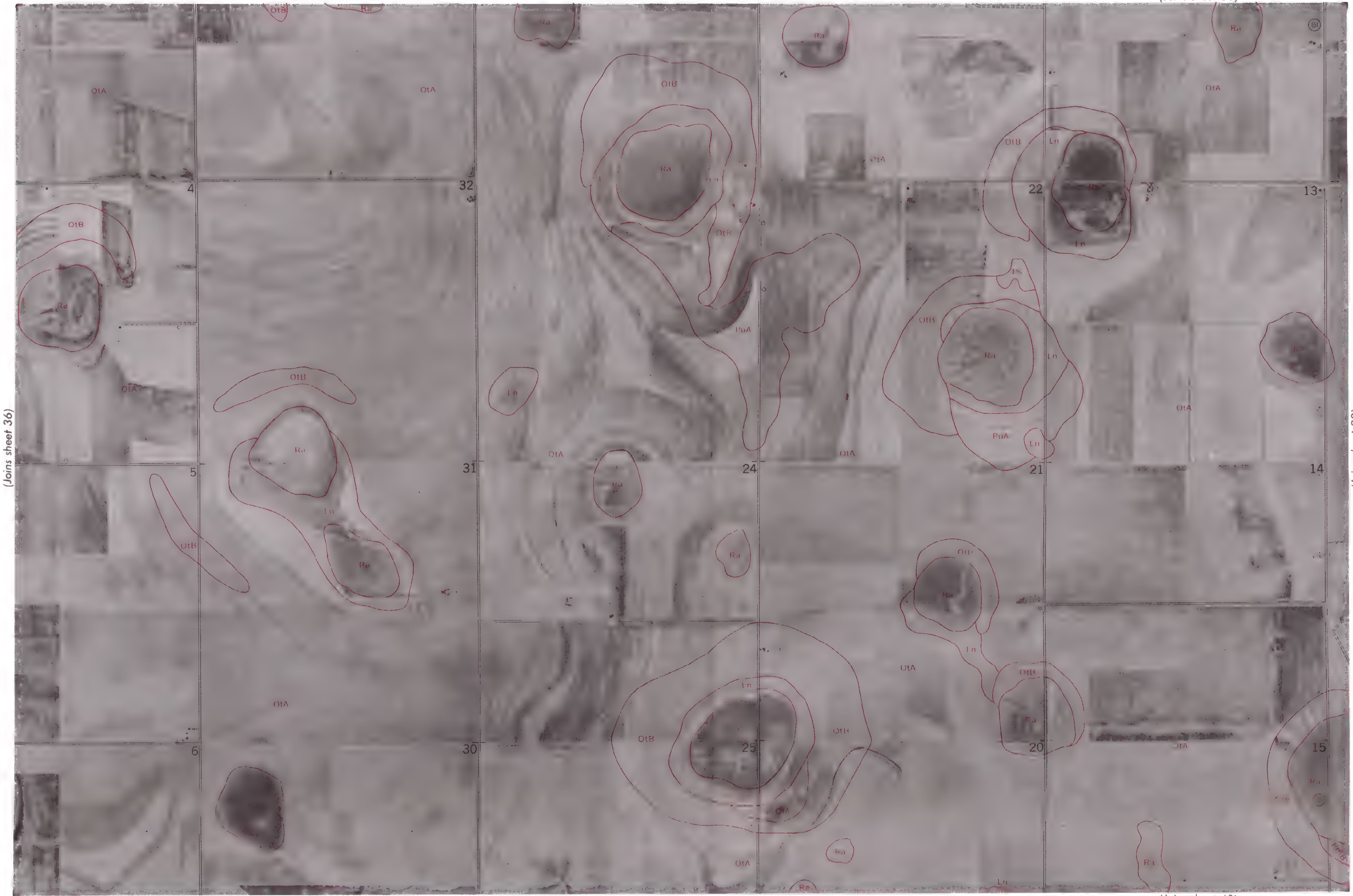
(Joins sheet 42)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

CROSBY COUNTY, TEXAS — SHEET NUMBER 37

(Joins sheet 30)

37



(Joins sheet 36)

(Joins sheet 38)

(Joins sheet 43)

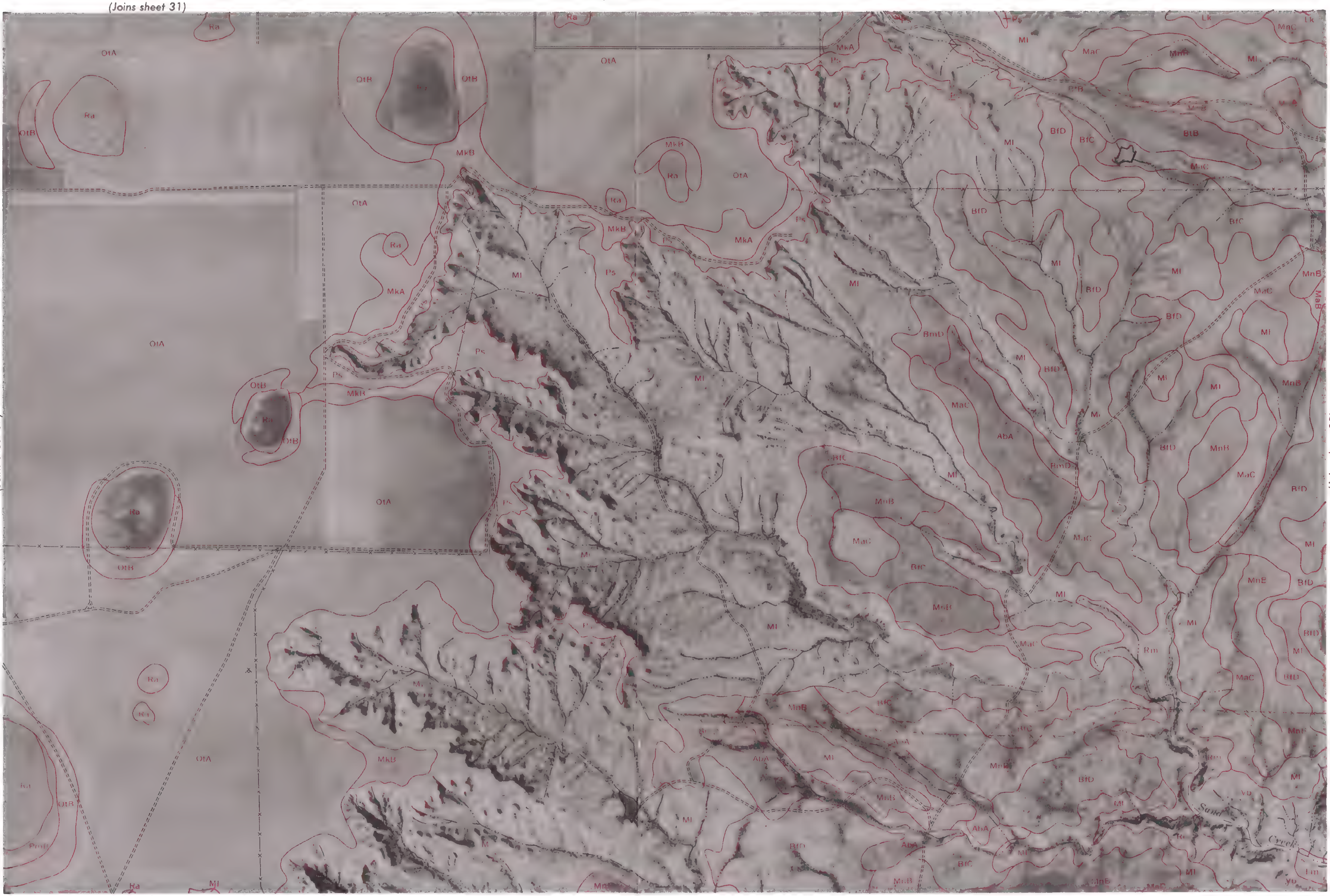
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

Land division corners and numbers shown on this map are indefinite.

38

(Joins sheet 31)

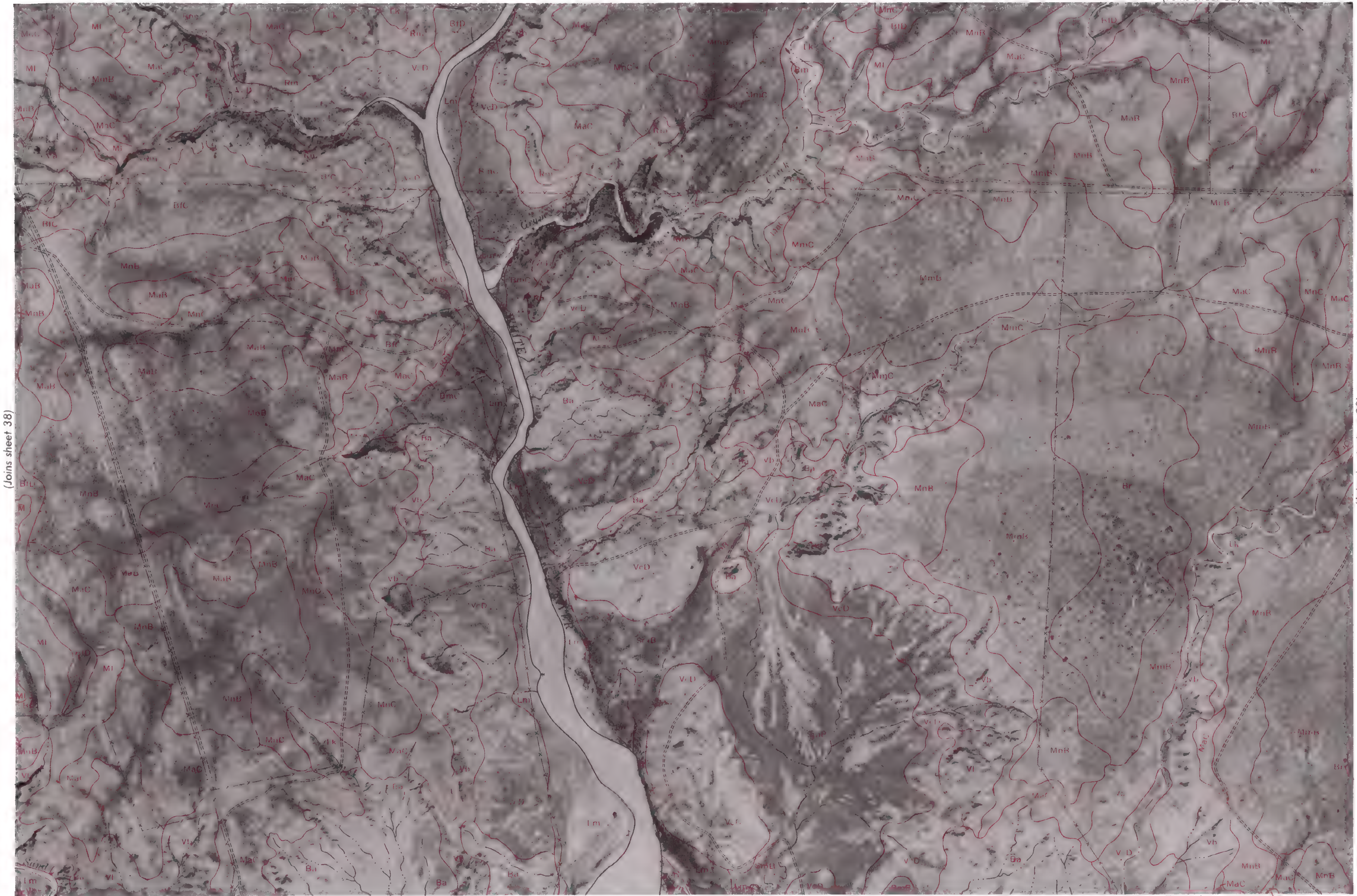


(Joins sheet 44)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 32)

39



(Joins sheet 38)

(Joins inset, sheet 33)

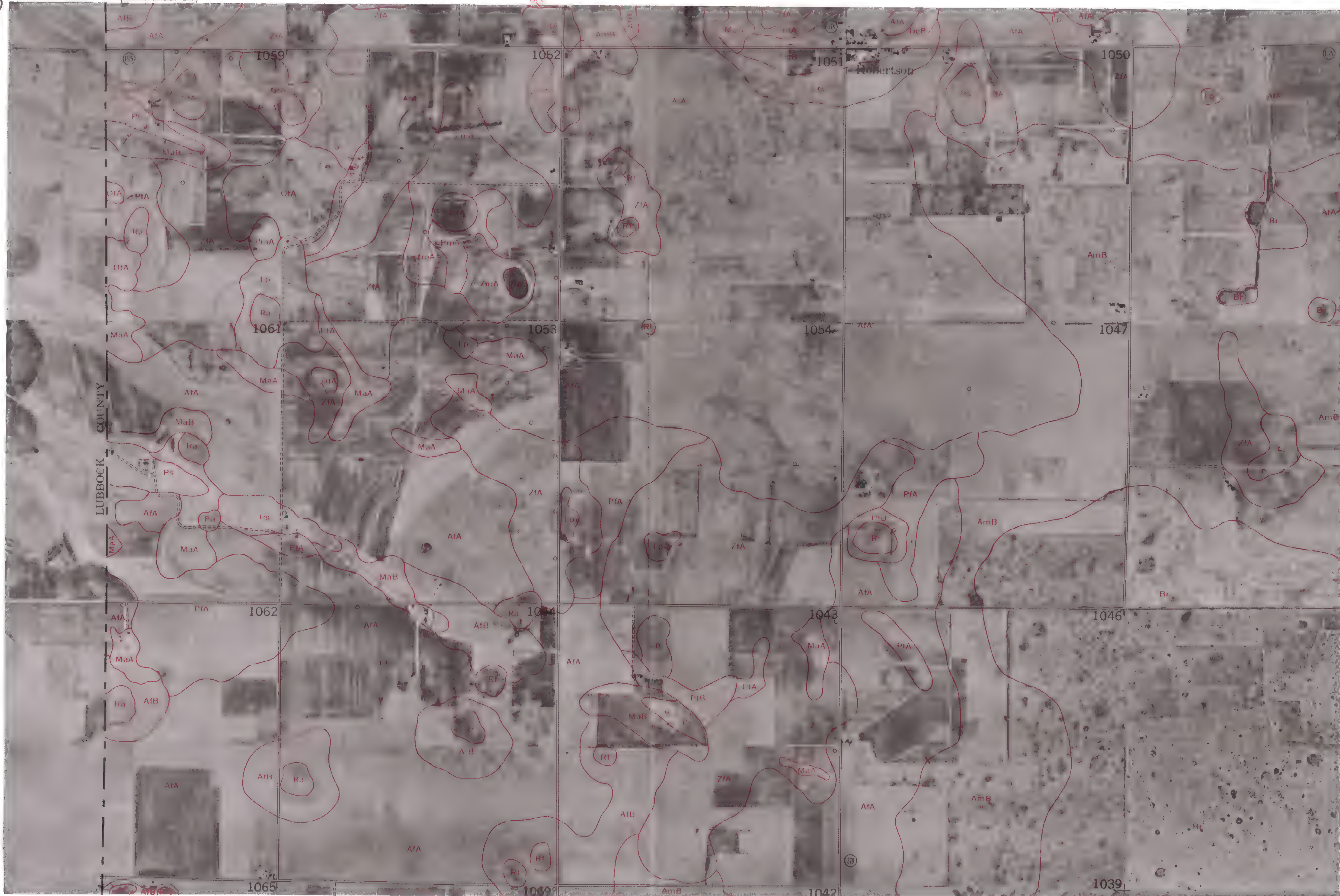
(Joins sheet 45)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.
Land division corners and numbers shown on this map are indefinite.

(Joins sheet 34)

N



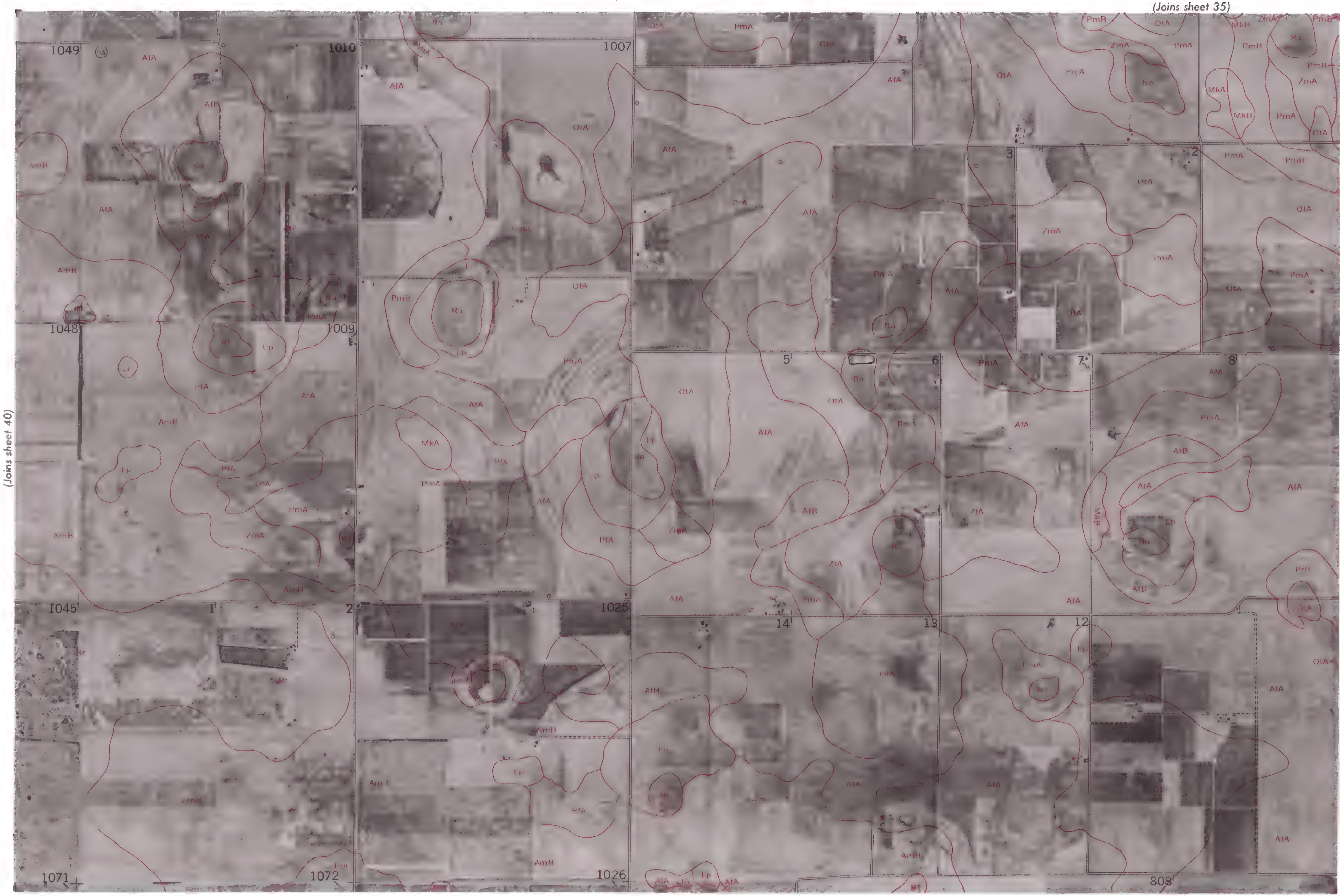
(Joins sheet 41)

(Joins sheet 47)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(41)

(Joins sheet 35)



(Joins sheet 48)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

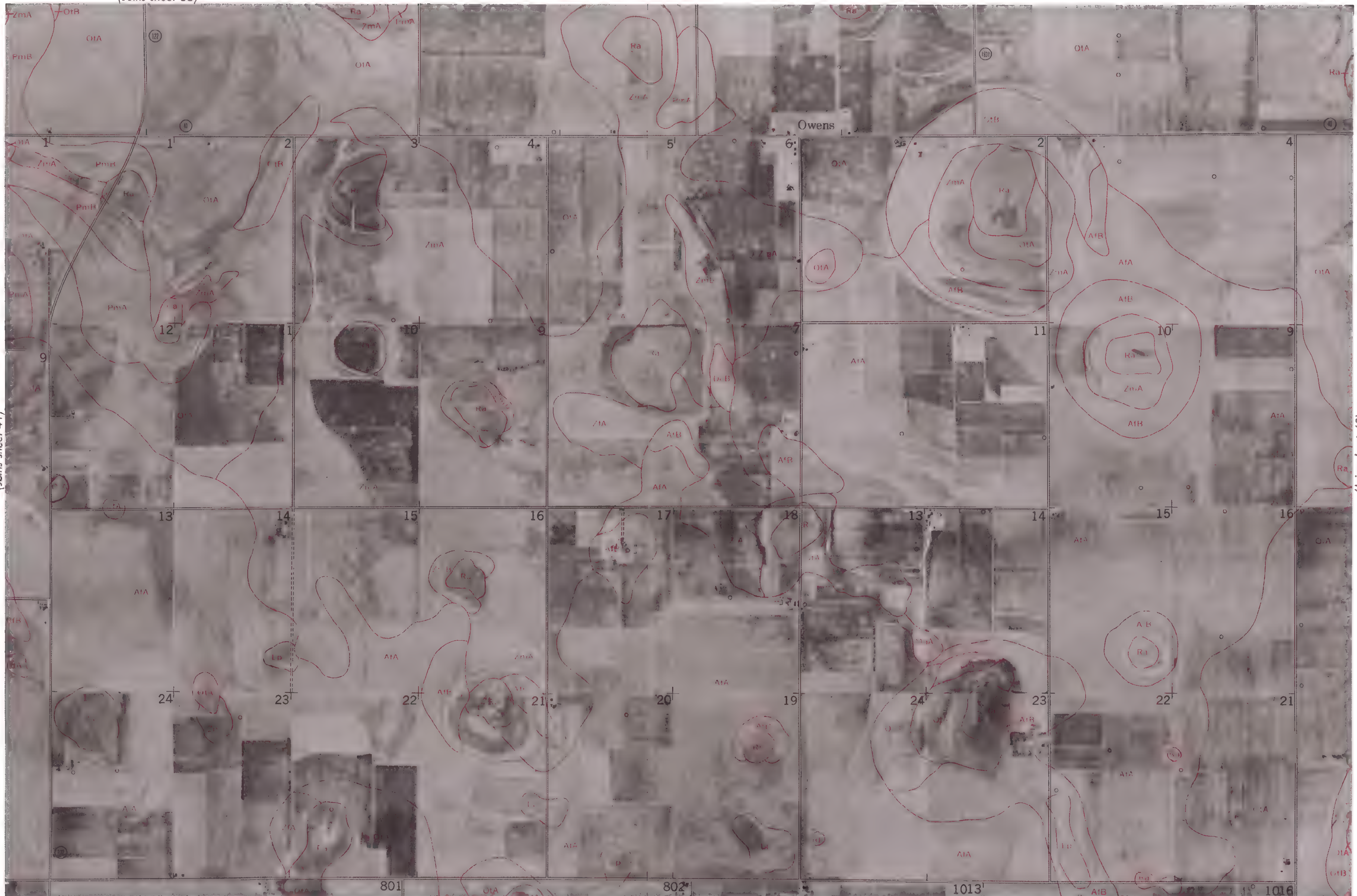
This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

(Joins sheet 36)

N

(Joins sheet 41)



(Joins sheet 43)

(Joins sheet 49)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

43

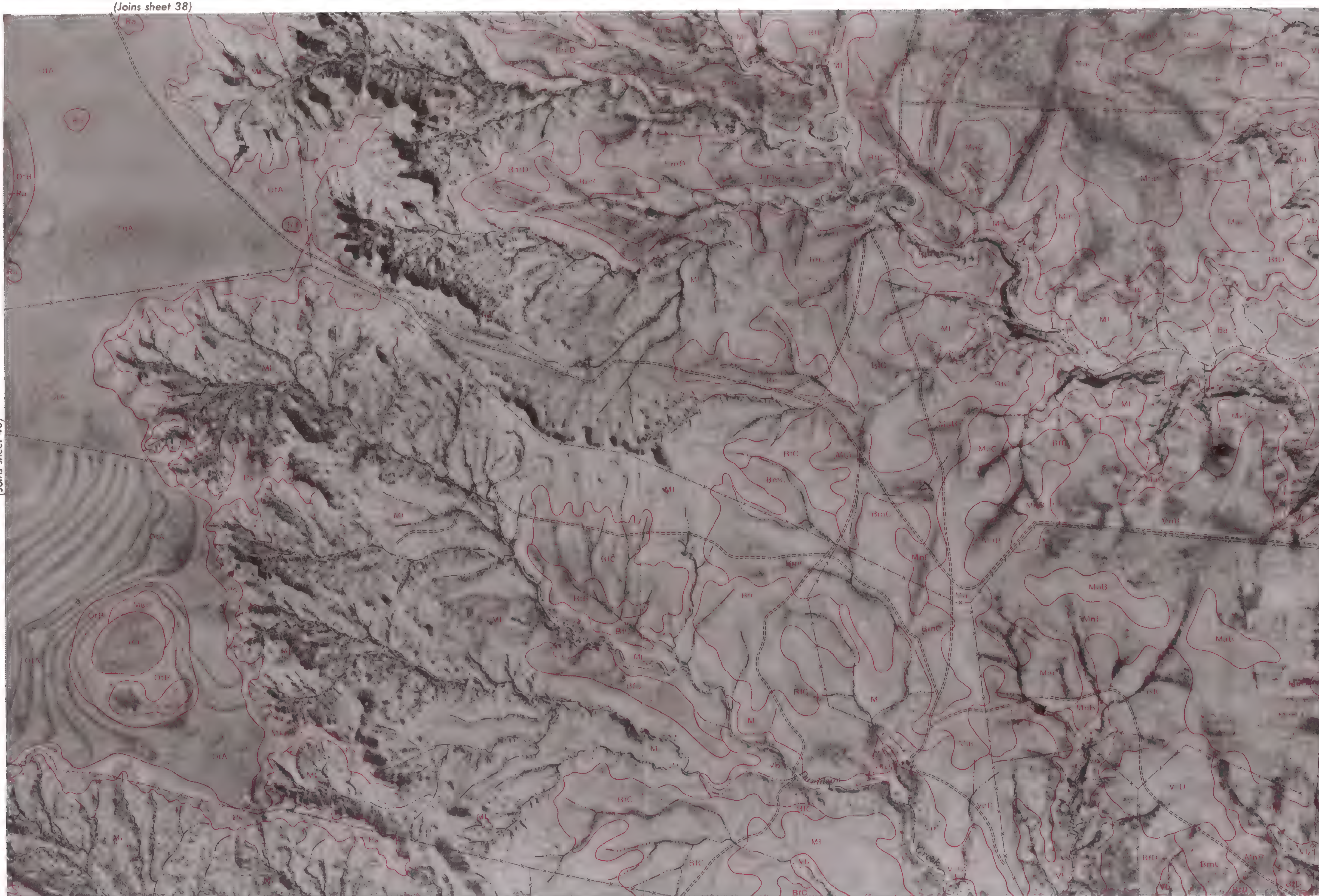
This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

44

(Joins sheet 38)



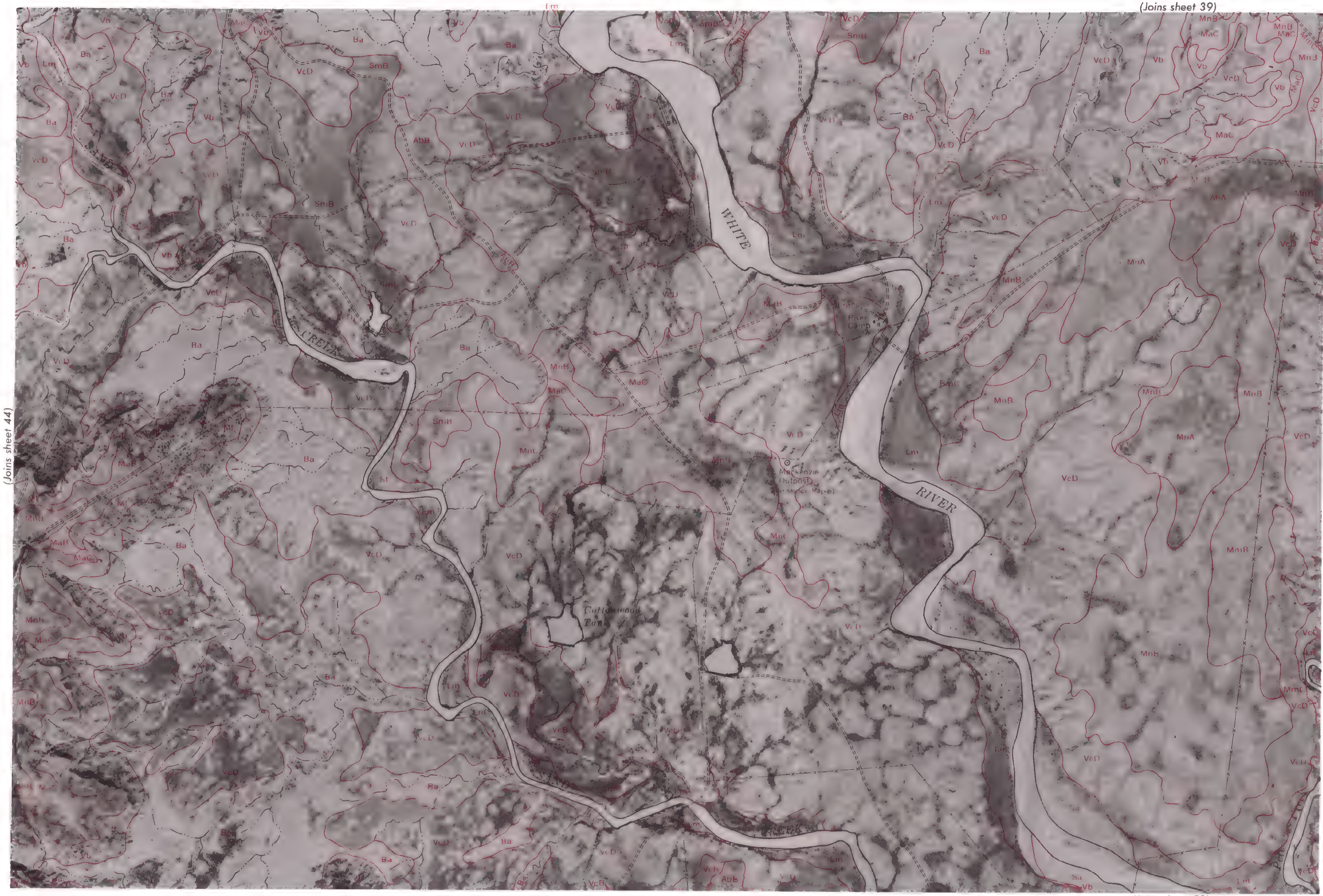
(Joins sheet 51)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 39)

45

(Joins sheet 44)



(Joins sheet 46)

(Joins sheet 52)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

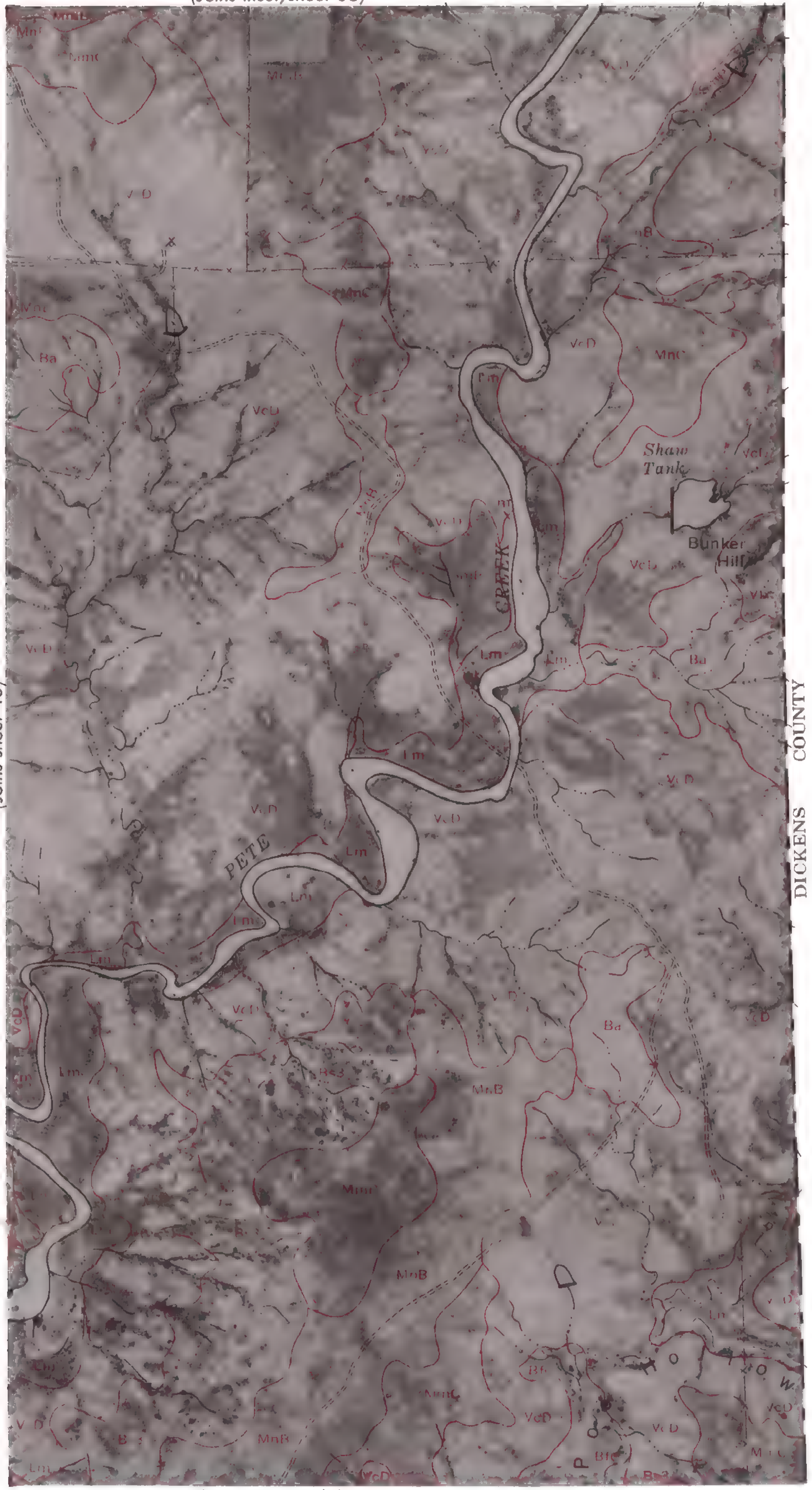
This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.
Land division corners and numbers shown on this map are indefinite.

46

N

(Joins inset, sheet 33)

(Joins sheet 45)



(Joins upper right)

(Joins lower left)

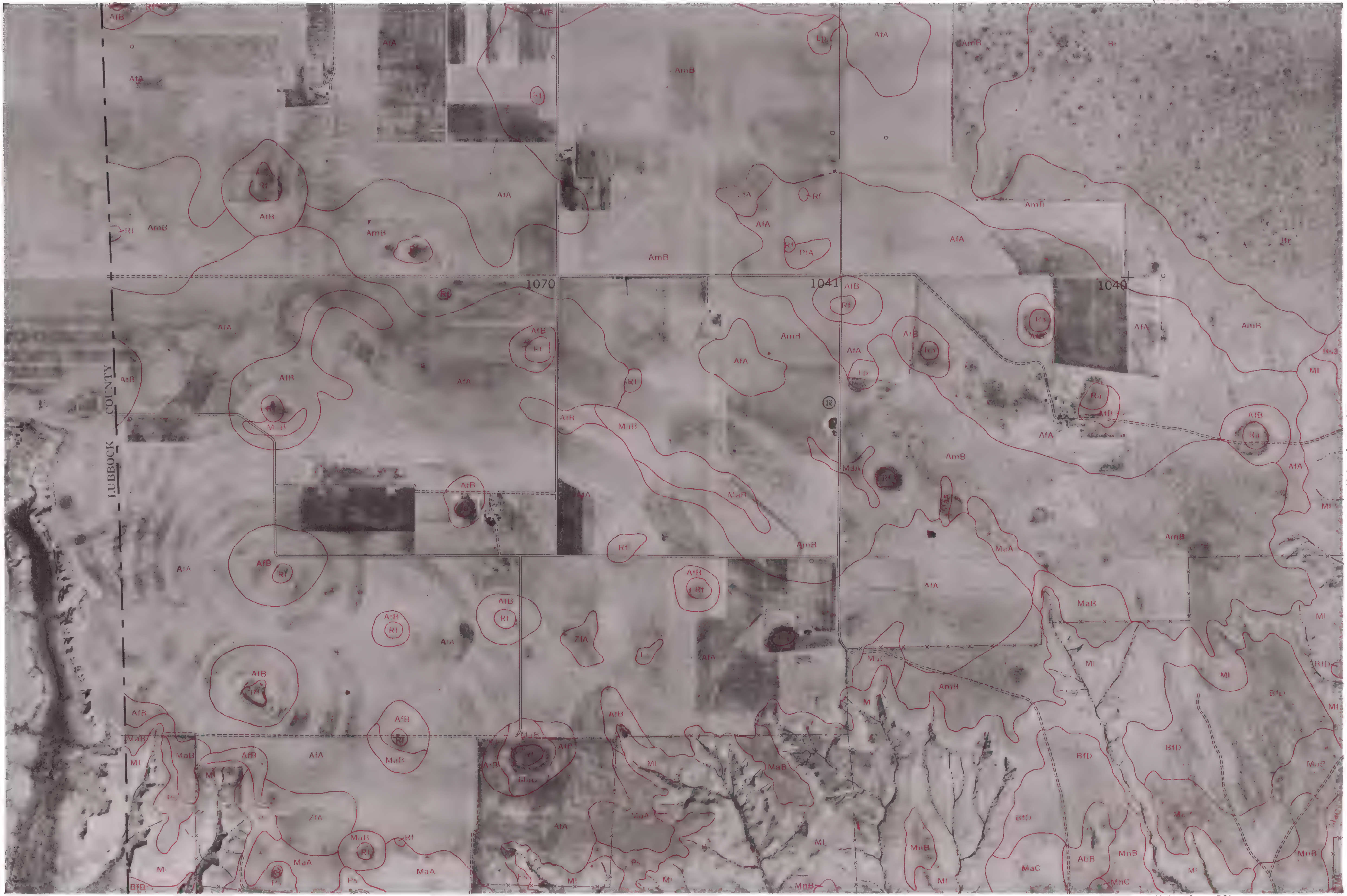
(Joins sheet 52)

(Joins sheet 59)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 40)

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.
Land division corners and numbers shown on this map are indefinite.



N

(Joins sheet 48)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 53)

(48)

N

(Joins sheet 41)

(Joins sheet 47)

(Joins sheet 49)

(Joins sheet 54)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(Joins sheet 42)

N

(Joins sheet 48)

(Joins sheet 50)

(Joins sheet 55)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

Land division corners and numbers shown on this map are indefinite.

50

(Joins sheet 43)

(Joins sheet 49)

(Joins sheet 51)

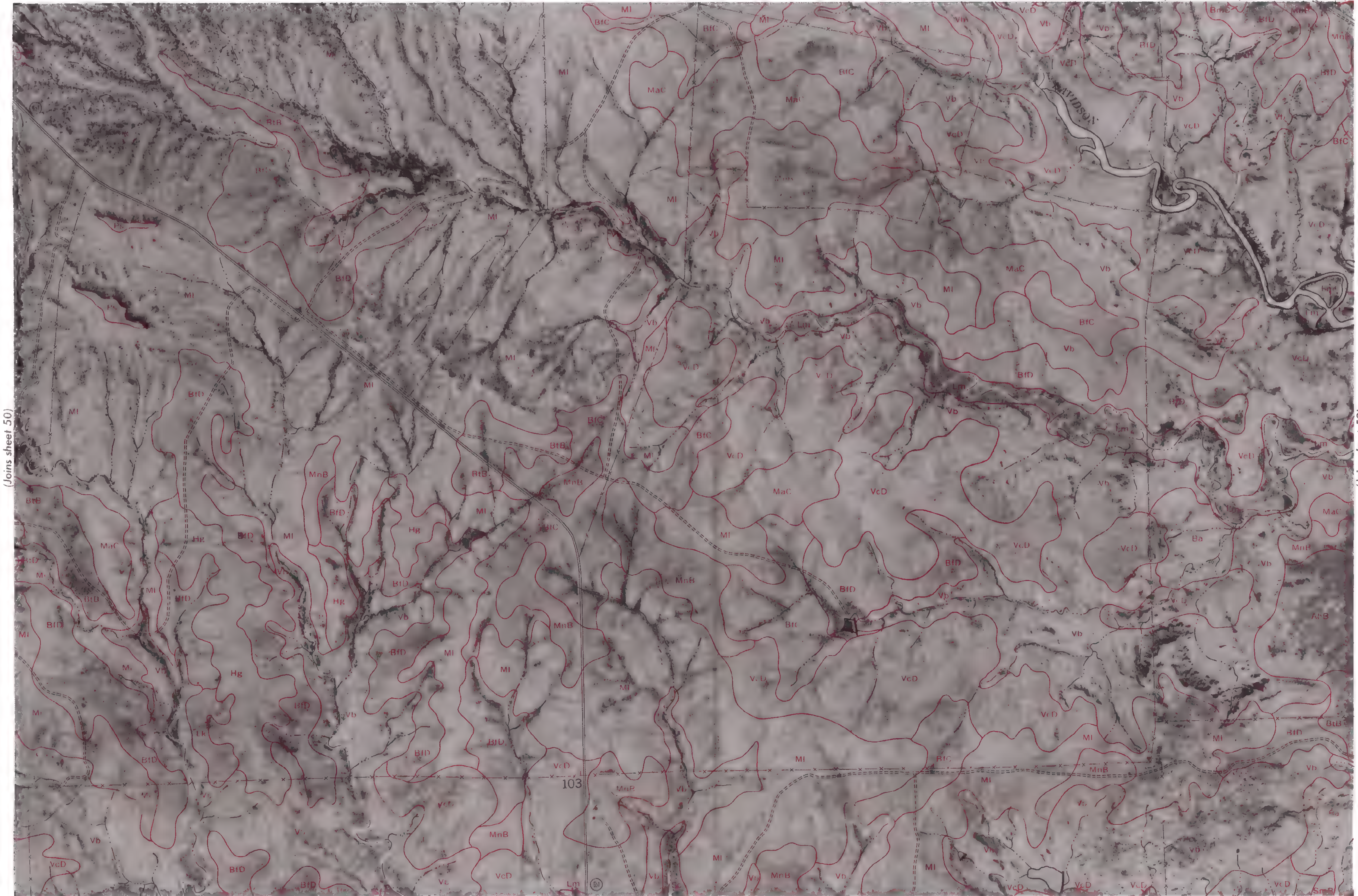
(Joins sheet 56)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(51)

(Joins sheet 44)

N



(Joins sheet 50)

(Joins sheet 52)

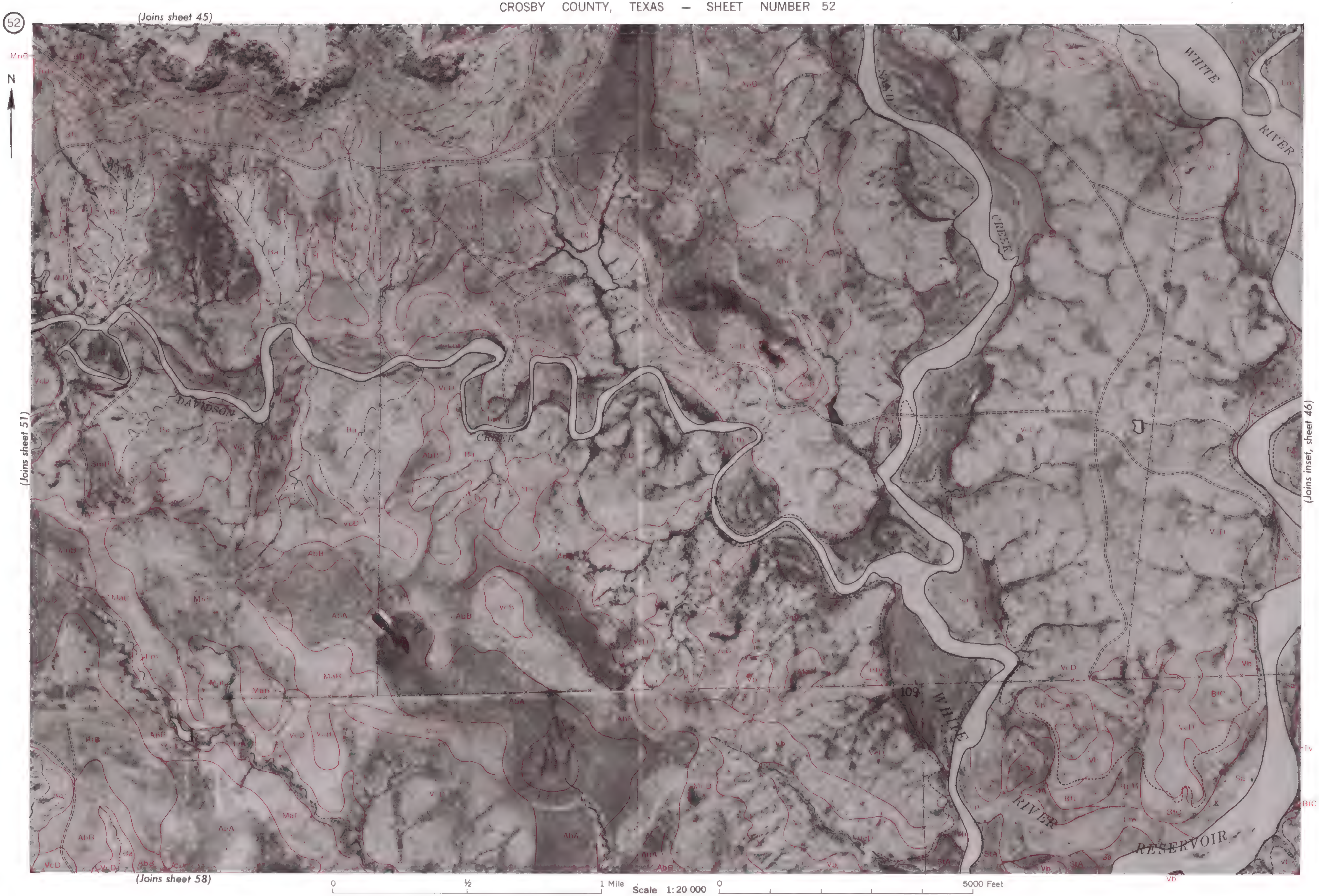
(Joins sheet 57)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

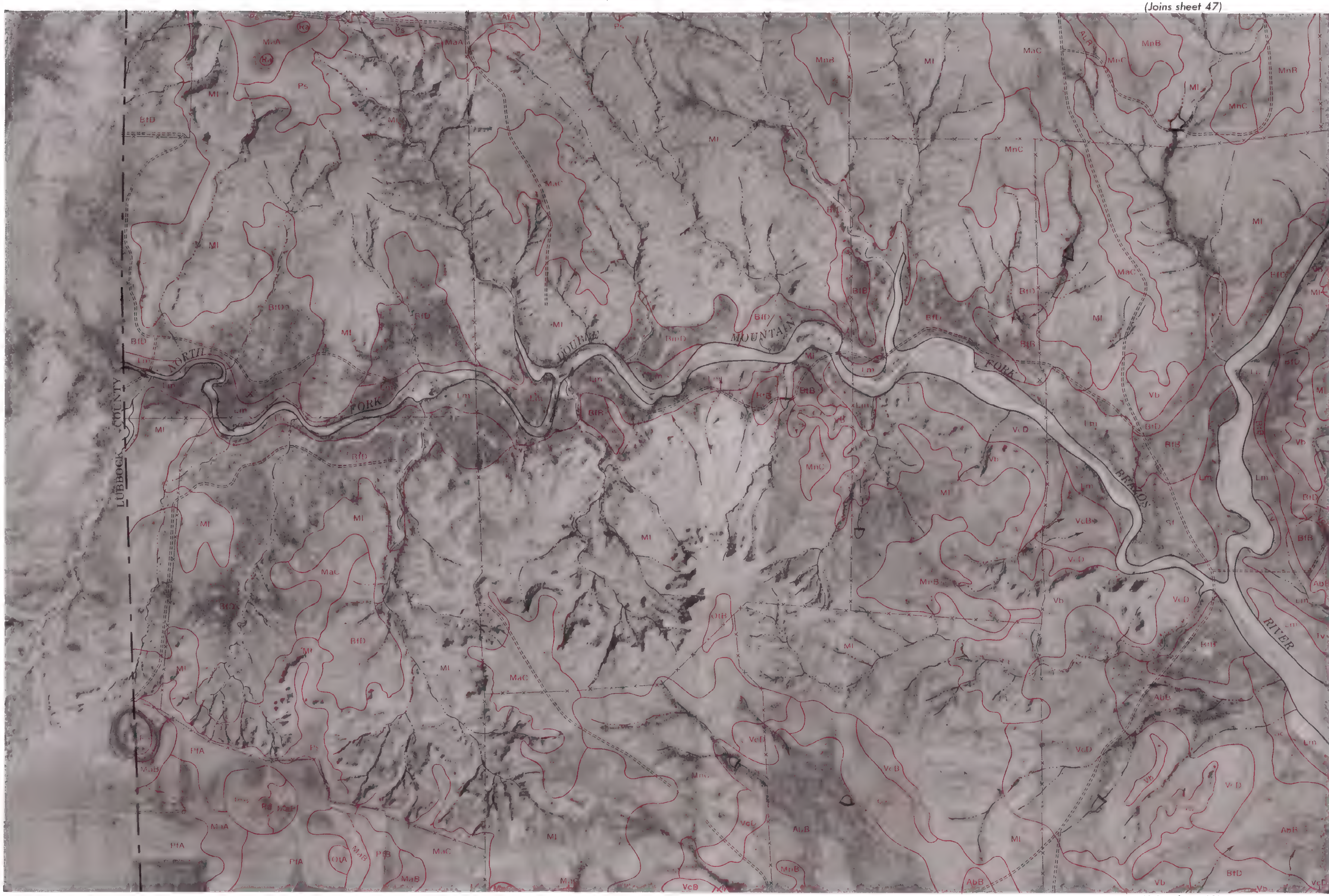
Land division corners and numbers shown on this map are indefinite.

52


(Joins sheet 45)
N
(Joins sheet 51)
(Joins inset, sheet 46)
(Joins sheet 58)
DAVIDSON
CREEK
WHITE
RIVER
RESERVOIR
109
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

(Joins sheet 47)

53



(Joins sheet 54)

(Joins sheet 60)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

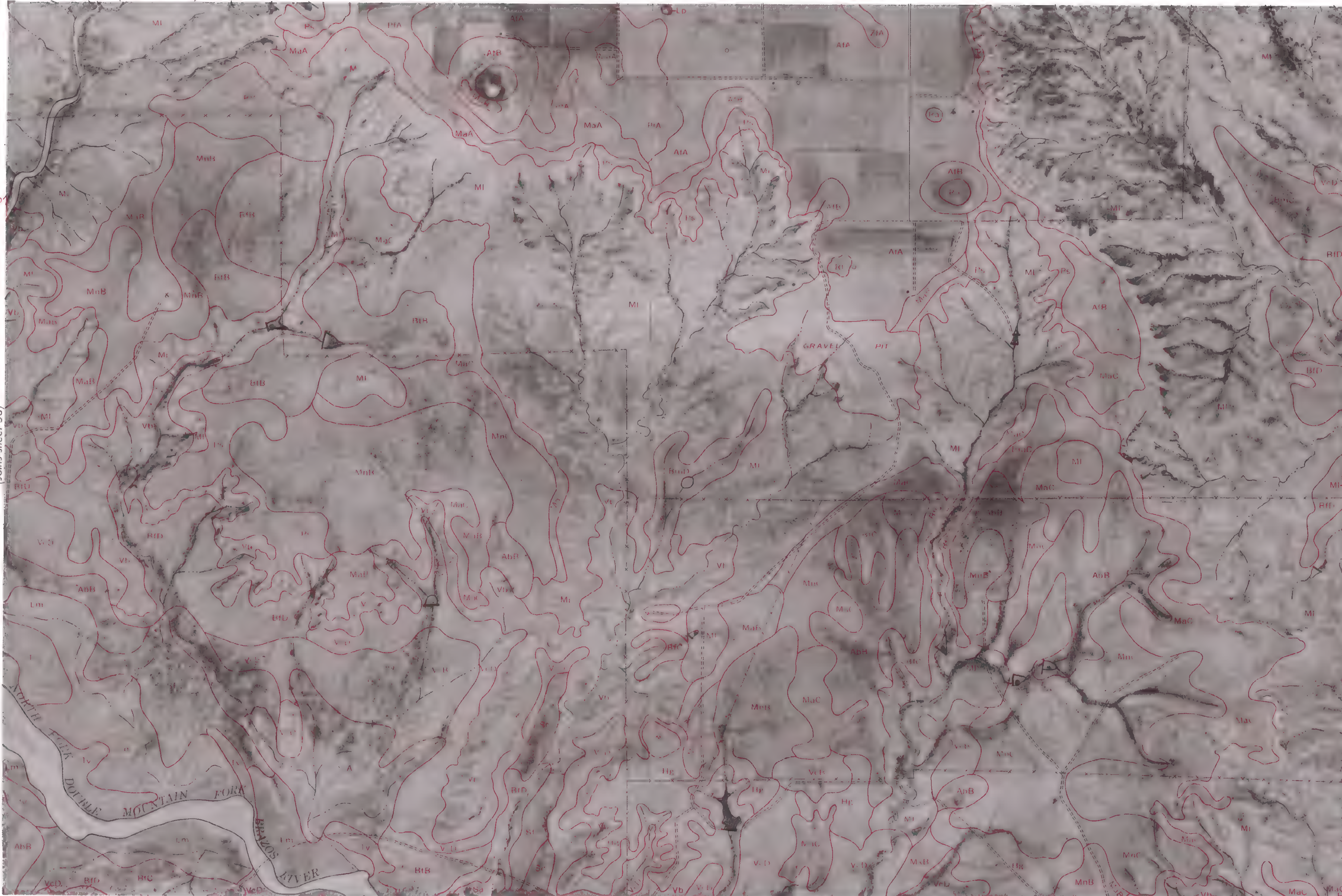
Land division corners and numbers shown on this map are indefinite.

54

N

(Joins sheet 48)

(Joins sheet 53)



(Joins sheet 55)

(Joins sheet 61)

0 ½ 1 Mile

Scale 1: 20 000

0 5000 Feet

(Joins sheet 49)

(Joins sheet 54)

(Joins sheet 56)

(Joins sheet 62)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

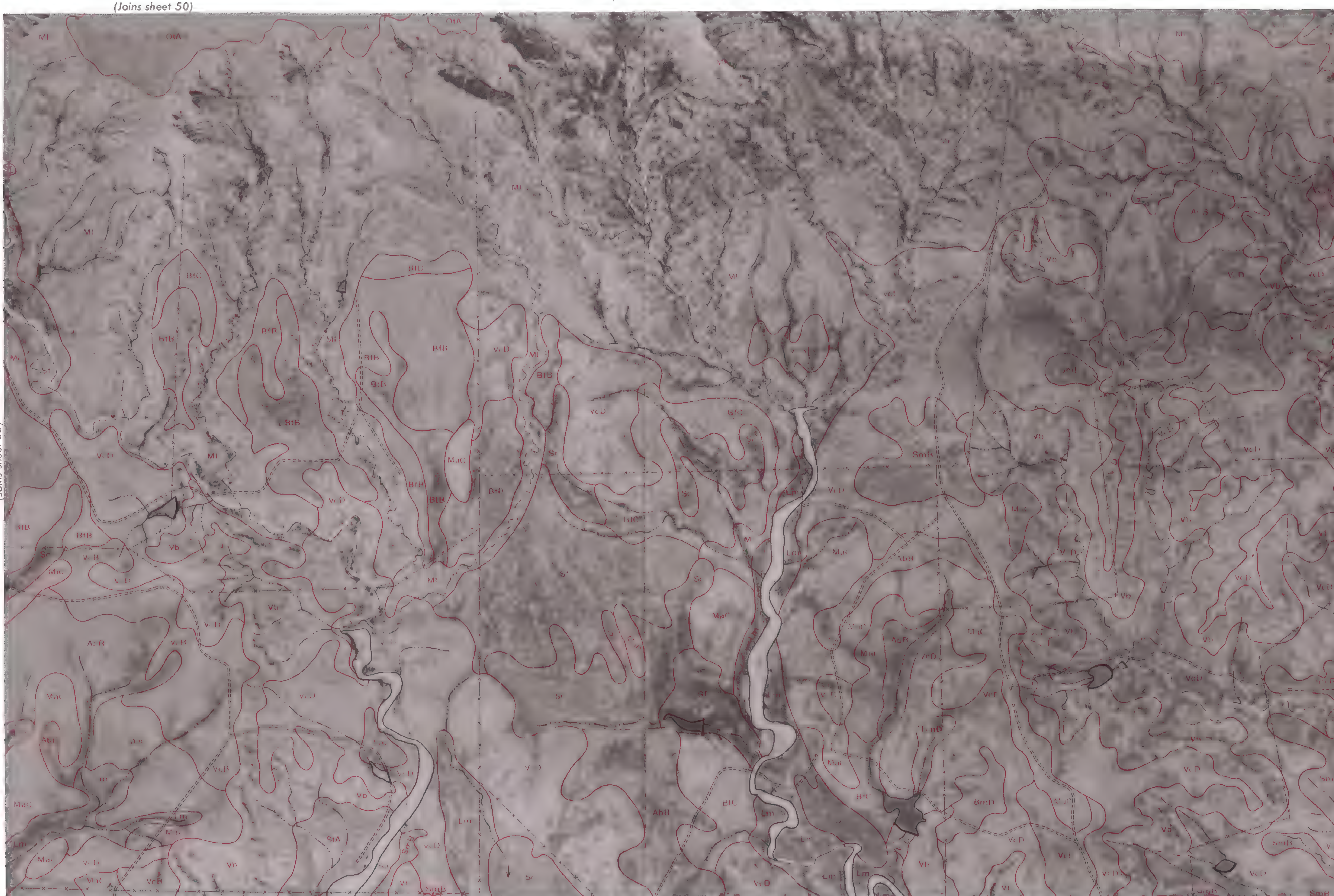
Land division corners and numbers shown on this map are indefinite.

56

(Joins sheet 50)

N

(Joins sheet 55)



(Joins sheet 57)

(Joins sheet 63)

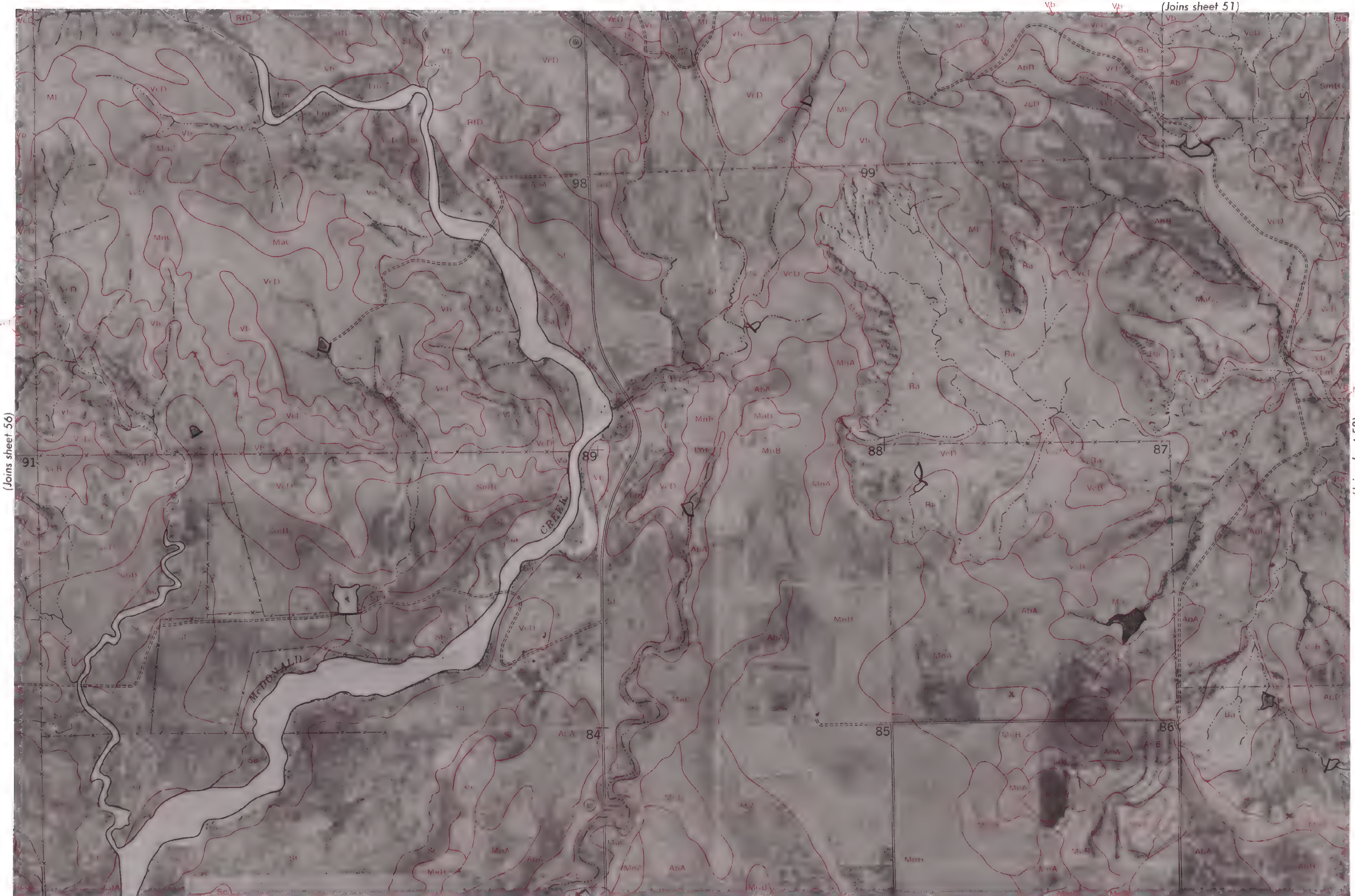
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

CROSBY COUNTY, TEXAS — SHEET NUMBER 57

(57)

(Joins sheet 51)

(Joins sheet 56)



(Joins sheet 58)

(Joins sheet 64)

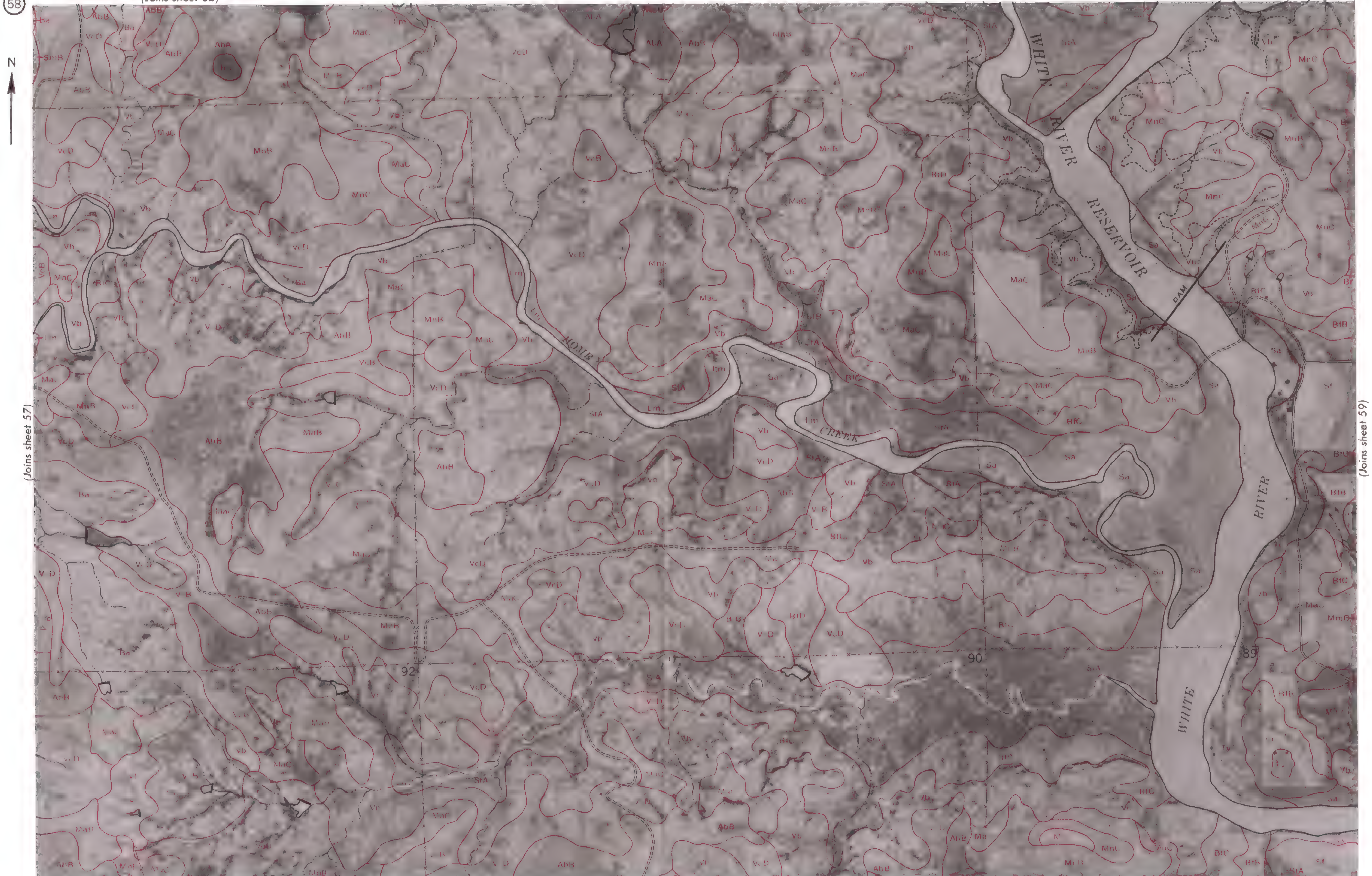
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

58

(Joins sheet 52)



(Joins sheet 65)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

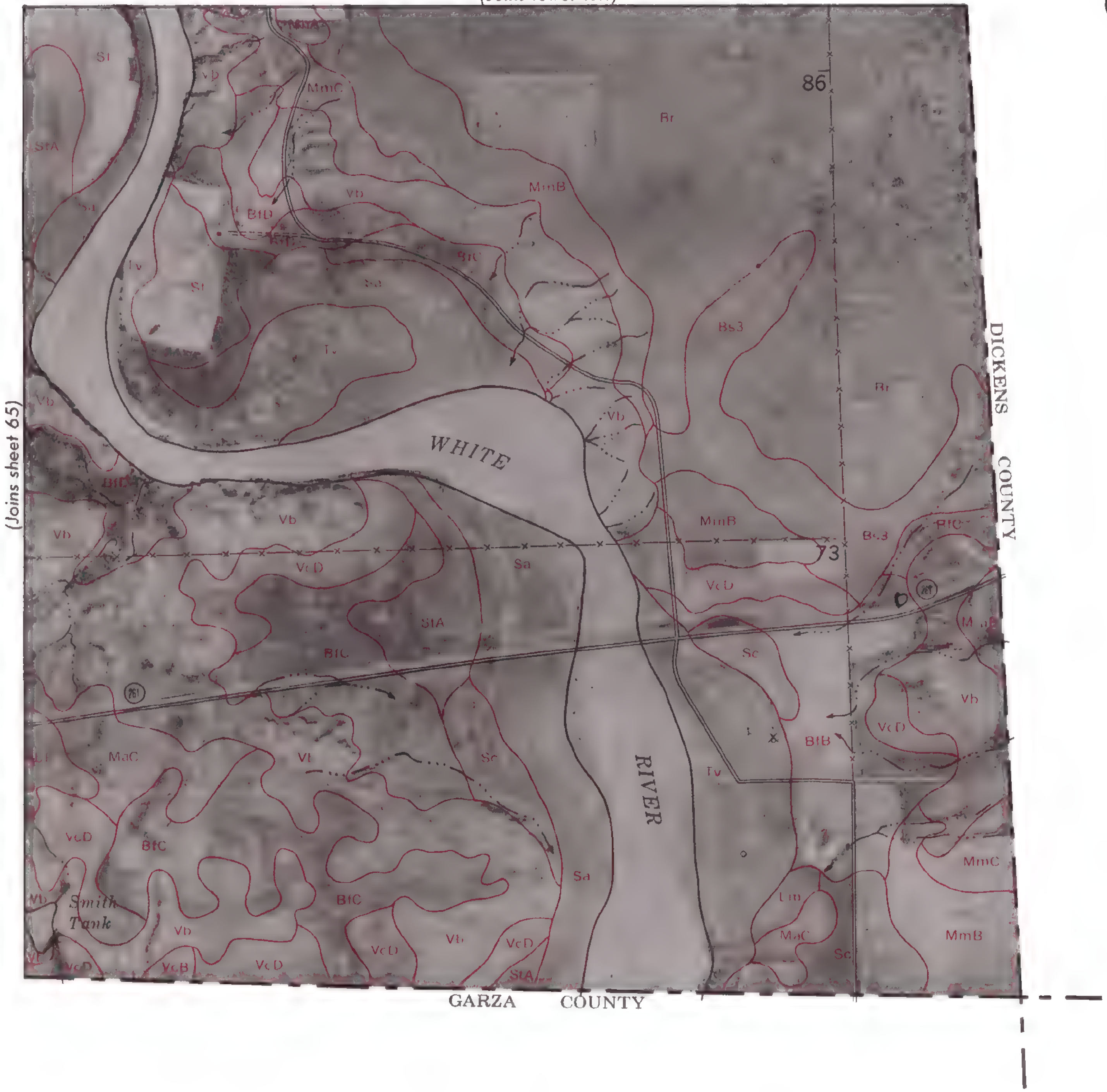
(Joins inset, sheet 46)

(Joins sheet 58)

(Joins upper right)

(Joins lower left)

(Joins sheet 65)



N

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

Land division corners and numbers shown on this map are indefinite.

CROSBY COUNTY, TEXAS — SHEET NUMBER 60

(Joins sheet 53)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 54)

61

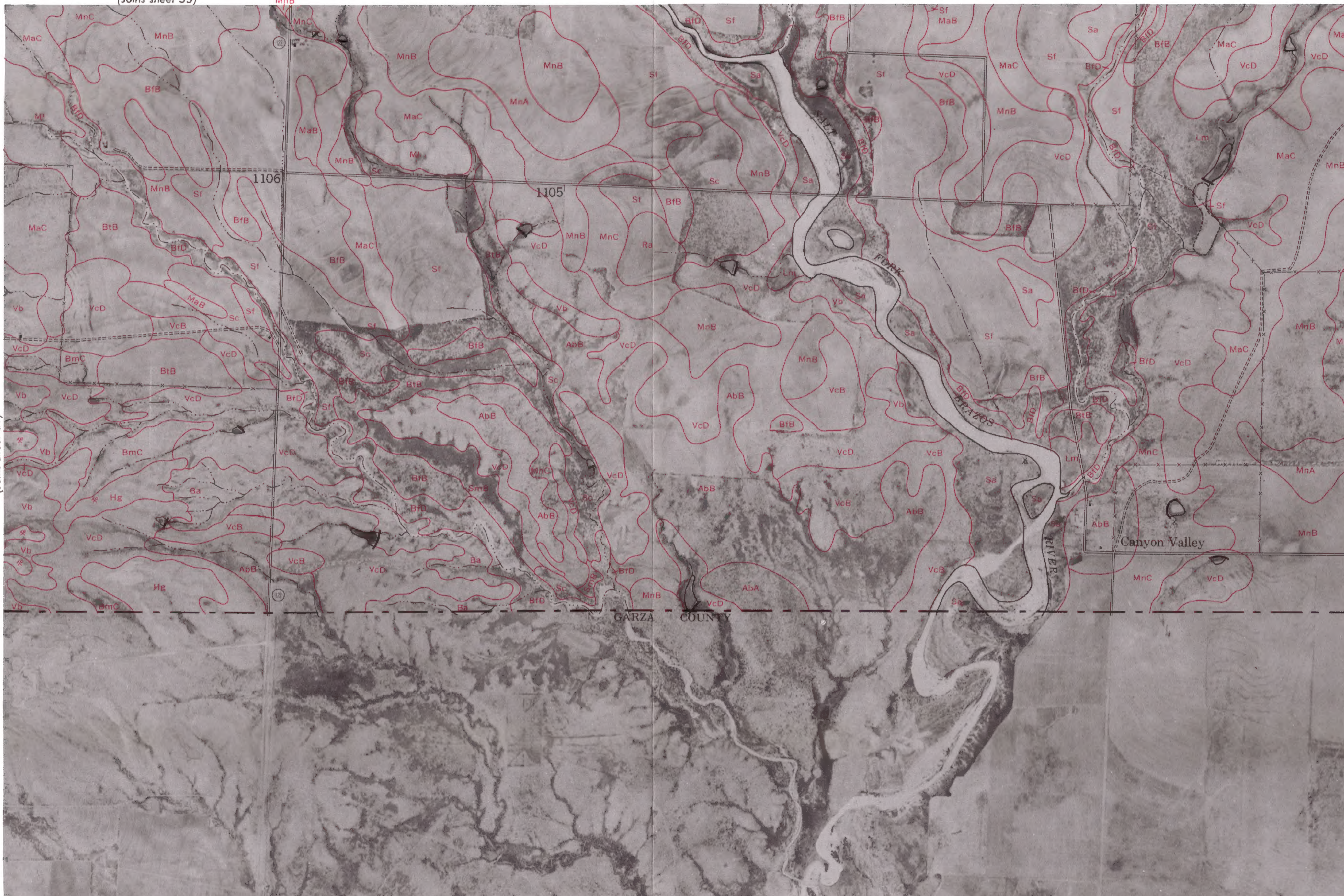
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

62

(Joins sheet 55)



Scale 1:20 000

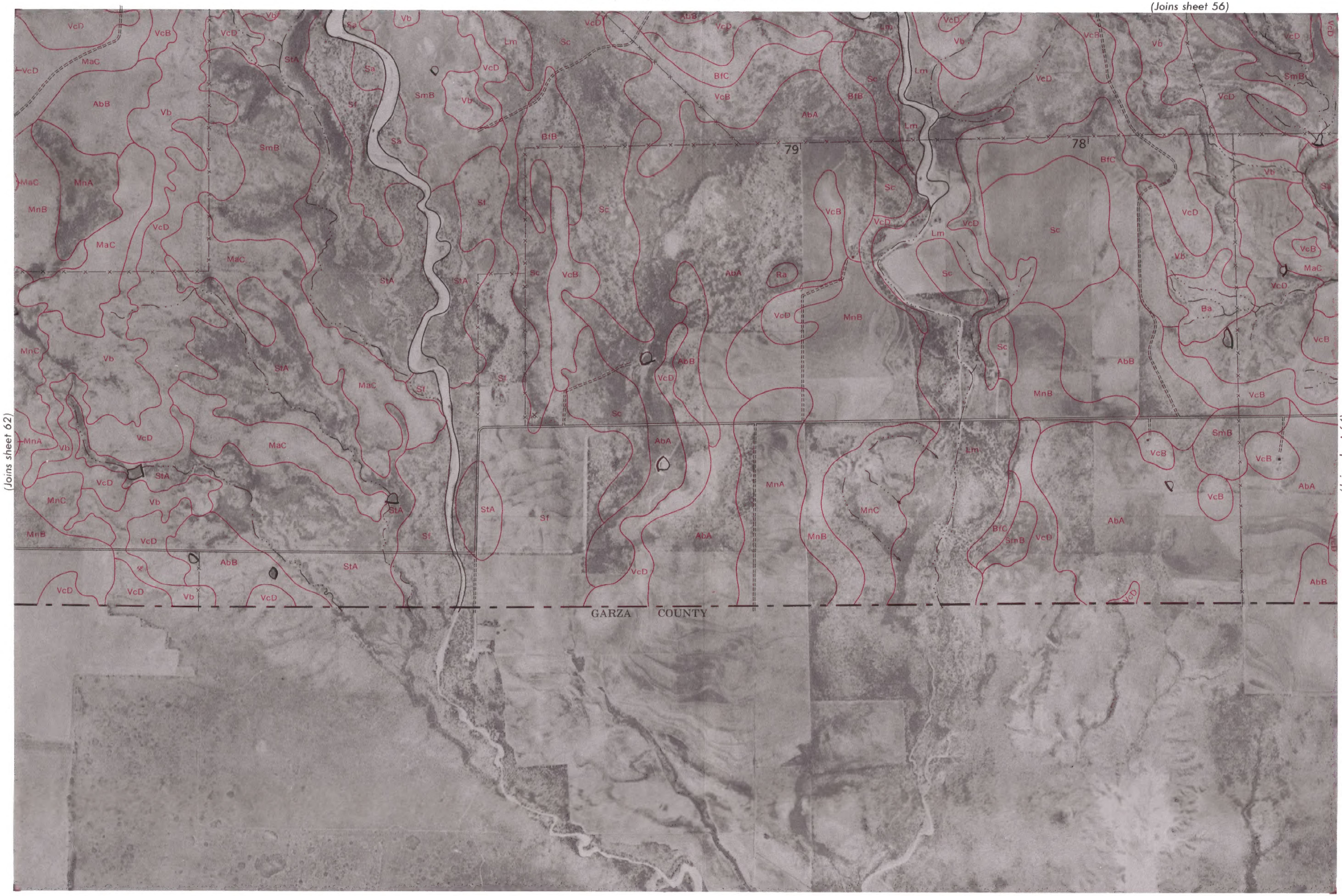
0 ½ 1 Mile

0 5000 Feet

CROSBY COUNTY, TEXAS — SHEET NUMBER 63

(Joins sheet 56)

63



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.

CROSBY COUNTY, TEXAS — SHEET NUMBER 64

(Joins sheet 57)

N

(Joins sheet 63)

(Joins sheet 65)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

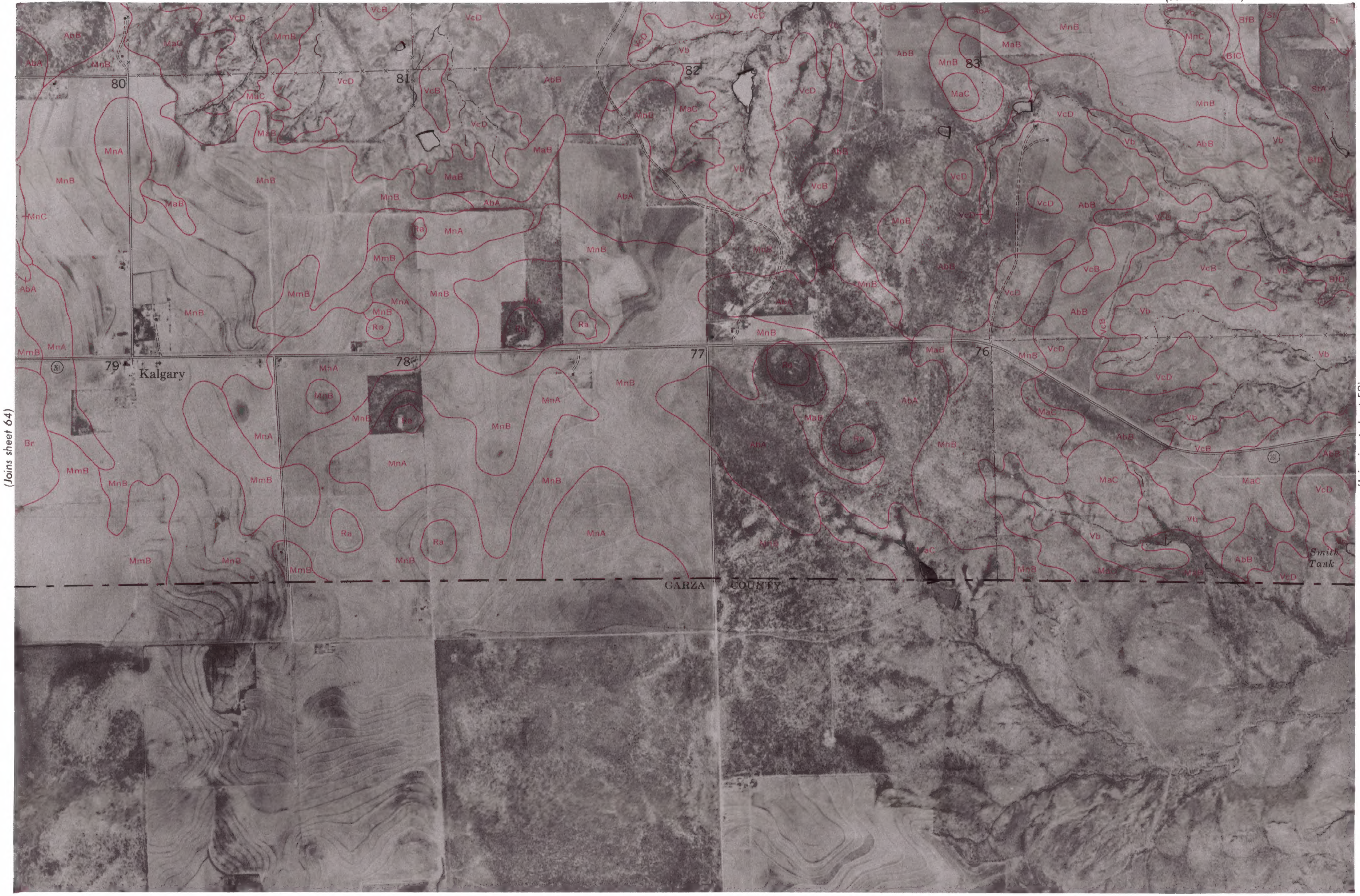
CROSBY COUNTY, TEXAS — SHEET NUMBER 65

(Joins sheet 58)

65

N

(Joins sheet 64)



(Joins inset, sheet 59)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

Land division corners and numbers shown on this map are indefinite.